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The MONTHLY REVIEW

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A Society for the Advancement of the Science of Electro-Plating

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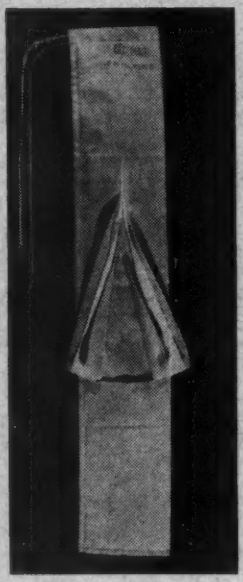

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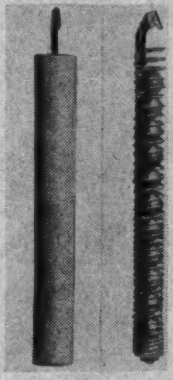

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Looking Forward

Editorial by CHARLES H. PROCTOR, Founder of the AES.

Looking backward through the mist of twenty-seven years, does not seem to be a long period in the infinity of Time, because we know the history of those years, which Memory brings to us all who have reached maturity and who have lived through the great problems that have been so pre-eminent during that time.

War, Devastation, Famine, Pestilence, and the World's greatest Depression.... And those of us who were born decades previous to 1907 well know and realize what all these great world problems cost, and what America has had to pay as a participant for "making the World safe for Democracy". Still, there are so-called Dictators that through their own personal ideas and ambitions would again tear the world apart.

The future and history alone can tell the story as the years elapse. As Americans we have Faith that through all of the World problems as well as our own internal problems that may develop in the future we shall stand as a bulwark—a great United Nation that can and must be a just arbiter in world affairs.

Since the founding of our Society in 1909 continued progress has been made. It has become one of the great Industrial, Educational and Scientific Societies in the United States and Canada. Its triumphant progress will continue if we remain united in furthering its ideals. Always united we stand; divided we fall.

The vision I first had when entering the Electro-plating field in 1889, in Ansonia, Connecticut, that some day in the future an effort would be made to create a great society based upon a practical and scientific foundation that would be representative of a great Metal Fabricating Industry that in 1889 was an integral part.

Then in 1907, through the aid of the Metal Industry in New York, an appeal was made to the platers of the United States for aid and support in creating a Society that would be truly representative of the electro-plating industry, the appeal resulting in the formation of the National Electroplaters Society of the United States and Canada, at the Astor House, in New York City, a land mark which has gone into oblivion, while New York has become the World's greatest city, and now in this the greatest city of the world, will be held the Twenty-fifth Silver Jubilee Convention, the greatest in all the Society's history, and every member of the Society should do his part to accomplish this ideal, whether official or just a plain member, and then, at its

close, start it on its big way through the lapse of another quarter century toward its Golden Jubilee.

All members of the Society will not be present when that auspicious occasion arrives, but as long as we live our memories will linger with the Society, and we feel quite sure that the efforts of its Founder will not have been in vain.

Those dear friends who have helped as co-workers have made the Society what it is today, and what it will continue to be in the future, as the older members leave the ranks and the younger men come forward and carry on the work, it will stand as a monument for all times.

I have reached the age of 71 years on the 25th day of February, 1937, and in the future I shall watch the progress of the Organization, as long as my mind stays active here in the splendid City of Clearwater, in Florida, where I have accomplished great things in the space of one year, and have become well known for my accomplishment.

We have as awards for Educational features of the Society, presented as Papers, at the Branch and Conventional meetings, both practical and technical, the Founders Gold Medal Awards; also the American Electro-Platers' Society Award for the best technical paper presented through the preceding year.

And now it is my earnest desire, with the consent of the Supreme Society, and the membership of the Society, to create another award, at the forthcoming Silver Jubilee Convention, in New York City, June 14, 15, 16 and 17, 1937, and at each succeeding Convention, during my lifetime, The Herminie Dorothea Proctor Award of One Hundred Dollars, for the best paper presented at the Convention, and future Conventions, the Committee of Awards being the deciding factor.

This Award is made in memory of my beloved wife and companion, whose sudden demise occurred on October 10th, 1934—just one month after our return from our Around the World Trip, and it is my earnest desire that this award be accepted.

To every member of the Supreme Society, to every Branch President and officials, and to every member of the Society, I send my New Year's wish and blessing, as the father of the Society, that happiness and prosperity and the love of country may continue with them, through the coming year, and through all the years that may be allotted.

To the Executive Members of the Board of Managers the same felicitations are expressed: Thos. F. Slattery, E. Steen Thompson, P. J. Sheehan, J. W. Hanlon, and may your splendid work continue for the good and welfare of the Society.

To W. J. R. Kennedy, Executive Secretary and Editor-in-Chief of THE MONTHLY REVIEW, I congratulate you upon the splendid success that you have accomplished as Editor of the REVIEW, and I know you will continue with your splendid work to make the publication still greater.

CHARLES H. PROCTOR, *Founder* American Electro-Platers' Society (AES) Twin Palms, Clearwater, Florida

Brass Plating *for* Rubber Adhesion

OPERATION OF THE PLATING BATH

*H. P. COATS**

Read at Cleveland 1936 Convention

BRASS PLATING for rubber adhesion is somewhat different from brass plating for ornamental purposes. Brass plating for rubber adhesion requires close control of the copper : zinc ratio, while ornamental brass plating requires close control of color.[1,2]

A new plating bath may consist of the following:

	oz/gal
CuCN	3
$Zn(CN)_2$	2
NaCN	6.0

This bath should be adjusted by additions of either $NaHCO_3$, or NaOH to a pH of 10.7, employing nitro yellow as a colorimetric indicator. No Na_2CO_3 is added. Addition agents are not used. Cast brass anodes of 70 per cent copper and 30 per cent zinc are used. If an anodic current density of not over 4 amperes per square foot is used, the anode will corrode at the proper rate to replenish the bath.

Most rubber stocks adhere to brass plate, containing from 21 to 33 per cent zinc. Considerable plating is done at 27.5 per cent zinc, with a variation of plus or minus 2 per cent. For depositing brass of this composition, a cathodic current density of 8 to 10 amperes per square foot is used; the temperature is held at 90° F. plus or minus 5°; and a deposit of about 0.000,02 inches thick is made. The plating bath is agitated mechanically. Sodium cyanide is added at frequent intervals in small amounts in the proportion of about five pounds for each one thousand square foot plated.

Weekly analyses of the bath and daily analysis of the plate are made. Copper is determined by electrodeposition; zinc, by titrating with ferro cyanide, using diphenyl benzidine as an

* Firestone Steel Products Company.

1 Ferguson and Sturdevant, Trans. Electrochem. Soc. V. 38, p. 167.

2 Bennett, Trans. Electrochem. Soc. V. 23, p. 251.

internal indicator; and cyanide by distilling HCN into NaOH, adding KI and titrating with $AgNO_3$.

The throwing power of the plating bath is tested with a steel block containing ten holes one-half inch in diameter and varying in depth from 0.15 to 1.50 inches. The deepest hole that is properly plated is the measure of the throwing power. This is usually 1.35.

Crystals of plated brass are too small to be revealed by the microscope, but variation in the size of crystals of melted solid brass appears to make no difference in rubber adhesion. Variation in crystal size of electro-plated brass as revealed by the X-ray, apparently has no effect upon adhesion.

Brass that is tarnished will not usually adhere to rubber. Unless cyanides are well washed off, rubber will not adhere. Coatings on the brass, or rubber, which are soluble in the rubber at the temperature of vulcanization, will not usually injure adhesion. For instance, heavy metal soaps, paraffin, fats, fatty acids, cumar and hydrocarbons are soluble in rubber and they do not harm. Sodium soap, lacquers, paints, bakelite and water glass are insoluble in rubber and will prevent adhesion.

Rubber adhered to brass aged satisfactorily in contact with the brass. The writer has a solid tire which was vulcanized to a brass plated rim nine years ago. The rubber has aged inward from the air surface, but not from the brass plated rim surface.

The artificial rubber, DuPrene, will give very little adhesion to brass. Rubbers cured without sulphur will give very little adhesion to brass. Some rubber stocks will adhere to copper, some will adhere to nickel-zinc alloy, some will adhere slightly to copper-cadmium alloy and some will adhere slightly to copper-tin alloy. However, most of the fast curing commercial rubber stocks will not adhere to metals and alloys in general except the copper-zinc alloy in the alpha brass range.

EXPERIMENTAL

It is the purpose of this study to discover what the important factors are and to what extent they influence the deposition of brass. It is also intended to determine what in the brass affects its adhesion to rubber.

Since brass is composed of copper and zinc, the first step is to learn what in the operation of a brass bath determines the

resulting copper: zinc ratio in the plate. Then it is desirable to determine how rubber adhesion is affected by the copper: zinc ratio of brass. It would be expected that the role of impurities also needs investigation.

This, in general, will be the method of attack.

The formulae of basic baths used in the following brass plating experiments are given below:

TABLE A

Bath No.	1	1A	2	2B	3	16A	16B	17	18
	Oz/gal	*Oz/gal.*	*Oz/gal*	*Oz/gal*	*Oz/gal*	*Oz/gal*	*Oz/gal*	*Oz/gal*	*Oz/gal*
"Unc." NaCN*	1.12	1.47	1.10	1.41	0.02	1.05	1.23	1.15	1.39
CuCN	2.40	3.20	2.70	2.90	3.00	2.30	1.36	2.80	2.42
$Zn(CN)_2$	1.25	2.66	1.45	1.44	2.00	1.29	0.63	1.44	2.45
pH	10.1	10.7	10.7	11.9	11.0	10.7	10.5	12.1	10.7

The following plating conditions were employed unless otherwise mentioned:

Current Density = 9 Amp. per Sq. Ft.
Time = 20 Min.
Temp. = 86° F.
1 Steel Cathode = 8" x 1", 16 sq. in.
Cell = 1200 cc.
2 Brass Anodes = 6" apart

Bath No. 1 contained the following in addition to the cyanides given above:

	g./L.	*m.g./L.*
NaC_2O_3	53.40	
NaCNO	8.25	
NH_4	1.02	
As_2O_3	..	0.5
Fe	1.00	

Bath No. 1 has been operated in the plant several years.

ZINC CYANIDE

Experiment I

To determine the effect of increasing the concentration of $Zn(CN)_2$ in the bath upon the per cent of zinc in the deposited brass.

* This NaCN is termed "Uncombined NaCN" in order to eliminate the controversial term "free cyanide." Sufficient NaCN is deducted from the total NaCN present to form $Na_2Zn(CN)_4$ and $Na_2Cu(CN)_3$ from all the $Zn(CN)_2$ and CuCN present in the bath. The remaining NaCN is designated "Uncombined."

Basic Bath No. 1 was used. A duplicate strip was plated for the purpose of observing the extent of variation. After plating two strips in the basic bath, the addition of 3.75 grams per liter of $Zn(CN)_2$ was made to that sample of the bath; then another 3.75 grams per liter addition was made to the same sample, making 7.5 g./L. total added. In this manner only one sample of solution of the basic bath was employed to plate the entire five series of this test. That is, the cell was not emptied during the test.

The $Zn(CN)_2$ was dissolved in NaCN in the proportion of 1.0 gram of $Zn(CN)_2$ to 0.84 gram of NaCN. A small amount of the bath was removed from the cell to make this solution in order not to dilute the bath.

The pH varied less than 0.1 during the test.

Table I (see following page) shows that increasing the concentration of $Zn(CN)_2$ in the plating bath increases the per cent of zinc deposited in the brass when other variables are maintained constant.

The brass deposited in this series averaged about .000,1 inch and did not become thicker as the concentration of $Zn(CN)_2$ increased in the bath. Usually, though, an increase in the concentration of metal salts in the bath produces a thicker deposit per faraday.

The cathode efficiency for this series varied from 27 to 34 per cent and only increased slightly with the increase in concentration of metal salts.

TABLE I

$Zn(CN)_2$ Added g./L.	*% Zn Deposited*	*Av. Increase in % Zn*
0	27.8	
0	27.2	
3.75	30.0	
3.75	28.9	2.0
7.5	29.2	
7.5	30.2	2.2
11.25	31.4	
11.25	31.8	4.1
15.00	32.3	
15.00	33.0	5.2

COPPER CYANIDE

Experiment II

To determine the effect of increasing the concentration of CuCN in the bath upon the per cent of zinc in the deposited brass.

Base bath No. 18 was employed.

The CuCN was dissolved by taking a small portion of the bath and adding CuCN and NaCN in the proportion of 1 to 1.1 grams, respectively. Only one strip was plated at each concentration. The plating time was ten minutes.

In other details this experiment was carried out the same as No. 1.

TABLE 2

CuCN Added g./L.	*% Zn Deposited*	*Decrease in % Zn*
0	35	..
3.75	25	10
7.50	19	16
11.25	14	21

Table No. 2 shows that increasing the concentration of CuCN in the plating bath increases the per cent of copper in the deposited brass when other variables are maintained constant.

Tables 1 and 2 show that the CuCN : $Zn(CN)_2$ ratio of the bath controls the copper : zinc ratio in the deposited brass, when other variables are maintained constant.

SODIUM CYANIDE

Experiment III

To determine the effect of increasing the concentration of uncombined NaCN in the plating bath upon the cathode efficiency and upon the per cent of zinc in the deposited brass.

This experiment was conducted exactly the same as Experiment I, using base bath No. 1. The pH was 10.1 throughout. Basic bath No. 1 contained 8.4 grams per liter of uncombined NaCN.

TABLE 3

NaCN Added g./L.	*% Zn Deposited*	*Cathodic Efficiency*	*Thickness of Plate in .000 in.*	*Volts*
0	27.8	32.3	.08	3.0–3.1
0	27.2	33.5	.09	3.1–3.15
1.9	26.4	23.5	.06	2.5–3.0
1.9	26.6	25.9	.06	2.9–3.0
3.8	24.9	19.4	.05	2.5–2.7
3.8	25.4	23.3	.06	2.6–3.0
5.7	25.2	16.5	.05	1.8–2.7
5.7	26.2	22.8	.06	2.5–2.8
7.6	25.2	18.7	.05	1.8–2.6
7.6	26.1	28.6	.07	1.6–2.7

Thickness of plate and cathodic efficiency agree fairly well in Table 3, because the copper: zinc ratio of the bath does not vary appreciably.

The cathodic efficiency decreases with increased concentrations of sodium cyanide but the decrease is not uniform. If the first strips of each duplicate set are compared and the second strips are compared, the decrease in cathodic efficiency is more uniform; so is the decrease in thickness of plate. It is necessary to neglect the last result in the "cathodic efficiency" column, for which there is no explanation. It is possible that the effect of adding the sodium cyanide was more pronounced on the first strip plated in each case after the addition, and that the second strip showed the effects less because it was plated twenty minutes after the addition. This relationship is shown to some extent in the per cent of zinc in the deposited brass.

The addition of sodium cyanide tended to decrease the per cent of zinc in the deposited brass but this effect is more pronounced when the uncombined sodium cyanide is less than it is in this bath, as the next experiment will illustrate.

Experiment IV

To determine the effect of increasing the concentration of NaCN in the plating bath upon the per cent of zinc in the deposited brass.

Base Bath No. 3 was employed. Plating time was twenty minutes. The pH was 11.0 throughout.

TABLE 4

NaC N Added g./L.	*% Zn Deposited*	*Thickness of Plate in .000 in.*
1.9	49	.16
2.8	48	.11
3.8	29	.14
4.7	28	.13
5.7	17	.17

The per cent of zinc in the deposited brass decreases much more rapidly in Table 4 than in Table 3, but the decrease is still not uniform. The first two results shown in Table 4 may be partially accounted for by the very low concentration of NaCN. The last two plated strips were the only ones that possessed the desired canary yellow color. There was no adhesion of rubber stock "B" (described in Experiment XV) to the first two strips, but satisfactory adhesion was obtained with the last three strips. There was no adhesion at all to any of the strips with rubber stock "C".

It is pointed out in Table 3 that the concentration of uncombined NaCN in the bath when the last two strips were plated was 16 grams per liter (8.4 original and 7.6 added) while in Table 4 the last strip was plated in only 5.85 grams per liter of uncombined NaCN.

The thickness of plate does not decrease uniformly in Experiment IV as usually occurs when successive amounts of NaCN are added to a brass plating bath.

It is not possible fully to explain the increase in thickness of the brass plate in the last strip of Experiment IV. A partial explanation, however, could be that the very high per cent of copper in the plate caused it. (One faraday at 100 per cent cathodic efficiency will deposit 63.57 grams of copper from CuCN, while only 32.69 grams of zinc will be plated under the same conditions from $Zn(CN)_2$.) Another possible explanation is that there is not an excessive amount of NaCN present.

It should be explained that bath No. 3 is abnormal in regard to its low concentration of sodium cyanide. No such wide variations in per cent of zinc deposited would result from a normal bath.

Experiment V

To determine the effect of pH on the zinc content of the deposited brass.

This experiment was conducted as follows: A sample was taken from a factory bath (basic bath No. 1A) which had a pH of 10.7. Sodium hydroxide was added as indicated to this sample. Another sample was then taken from the same bath, but sodium bicarbonate was added as indicated. A sample was then taken from basic bath No. 2B having a pH of 11.9. Sodium hydroxide was added as indicated. Plating time was ten minutes.

TABLE 5

Additions g./L.	*pH*	*% Zn*
11.2 $NaHCO_3$	10.3	20.0
7.5 $NaHCO_3$	10.5	20.1
1 ..	10.7	25.2
1.9 NaOH	11.1	36.1
2.7 NaOH	11.5	38.2
0 ..	11.9	38.6
0.7 NaOH	12.1	44.5

Table 5 illustrates how the addition of sodium hydroxide or sodium bicarbonate affects the per cent of zinc deposited. Adding NaOH — that is, increasing the pH — will increase the per cent of zinc in the deposited brass. Adding $NaHCO_3$ — that is, decreasing the pH — will decrease the per cent of Zn in the deposited brass.

The permissible pH range of the plating bath only extends from 10 to 12.5. Outside this range, a red deposit results. These red colored brasses will not adhere to rapidly cured rubber stock. Red brass may be either high copper brass or high zinc brass.

IMPURITIES

Certain impurities are prone to enter the plant plating bath. Sodium carbonate gradually builds up in alkaline baths as they are operated, coming from carbon dioxide of the air and from the decomposition of sodium cyanide of the bath. A plant bath containing 240 grams of Na_2CO_3 per liter produced brass

plate with the same adhesion to rubber stocks that a new plant bath did with nearly no Na_2CO_3 present. All published formulae for ornamental brass plating require the addition of Na_2CO_3. However, the new baths built by the writer contain no Na_2CO_3.

Iron salts increase in concentration in plating baths as they are operated, coming from the steel tank if it is not lined, from the work that falls in the tank, from grounded steel steam coils, from wash water carried over, from impure brass anodes and from other sources. All CuCN and $Zn(CN)_2$ contain iron salts, as well as the city water used in dissolving them. However, a large portion of the iron can be removed by keeping the temperature low while dissolving these salts and filtering off the $Fe(OH)_3$ before adding the solution to the bath. Concentrations of Fe in the bath up to 1.0 grams per liter in an old plating bath yielded plate which adhered as well to rubber stocks as did a new plant bath which was practically free of iron salts. Still higher concentration (22.5 grams per liter) of Fe gave a dull plate which did not adhere satisfactorily to soft rubber stock.

Tin salts in much smaller concentrations in the plating bath produced dull brass plate and consequently poor adhesion with soft rubber.

Lead salts in the bath will coat the anodes with lead peroxide and increase the resistance beyond the voltage capacity of the generator.

Tin, lead, arsenic, nickel and iron may be found in both the brass anodes and the copper and zinc cyanides.

ARSENIC

Experiment VI

To determine the effect of increasing the As_2O_3 concentration of the bath upon the plating characteristics of the bath.

Arsenic is a well-known addition agent to ornamental brass plating baths, but nothing has been published about the mechanism of its reaction.

Base bath No. 1 was employed. Plating conditions were the same as in Experiment I, except after plating the duplicate strips the bath was discarded each time and the cell refilled with another sample of the base bath. The basic bath contained 0.5 milligram per liter of As_2O_3.

The As_2O_3 was dissolved in a small sample of the plating solution to which had been added an equal weight of Na_2CO_3. The pH did not change during the experiment. The voltage varied from 2.8 to 3.3.

TABLE 6

As_2O_3 Added m. g./L.	*% Zn Deposited*	*Average Variation in % Zn*	*g. of Brass Deposited*	*Av. % Variation in g. Brass*
0	27.8		0.2021	
0	27.2		0.2107	
4.2	33.0		0.2307	
4.2	32.6	+5.3	0.2224	9.8
10.4	31.6		0.2566	
10.4	31.6	+4.1	0.2437	21.2
49	27.6		0.2874	
49	28.0	+0.3	0.2881	39.4
100	24.8		0.2841	
100	25.1	−2.5	0.2774	36.0

Table 6 shows that a small concentration of sodium arsenite increases the proportion of zinc in the brass deposited from that bath. However, a greater concentration decreased the zinc content of the deposited brass in the above experiment.

Probably the most important effect illustrated in Table 6 is the increase of nearly 40 per cent in the weight of brass deposited when 49 milligrams of As_2O_3 per liter are added to the base bath. The cathodic efficiency increased 39 per cent.

It is probable that the deposition of arsenic metal during plating raised the hydrogen deposition potential and thereby decreased the evolution of hydrogen.

Experiment VII

To determine whether or not arsenic is deposited when small concentrations of As_2O_3 are added to the bath.

Basic bath No. 1A was employed. There was 0.05 m.g./L. of As_2O_3 in the basic bath. This experiment was carried out similar to Experiment VI.

TABLE 7

m.g./L. As_2O_3 Added to Bath	*m.g. of As Found in Plate*
0	0.0015
1	0.0240
1.5	0.0365
2	0.0455

Table 7 illustrates that when arsenic, even in small amounts, is used as an addition agent it is deposited from the bath alloyed with the brass. (Large amounts of arsenic were deposited in Experiment VI.)

NICKEL

Experiment VIII

To determine the effect of adding nickel to the bath upon the plating characteristics.

Small amounts of nickel will produce bright brass plate similar to arsenic.

This experiment was carried out exactly the same as Experiment VI, using basic bath No. 1. The pH did not change during the experiment. The volts varied from 2.9 to 3.3.

TABLE 8

m.g./L. $NiSO_4.6H_2O$ Added	*% Zn Deposited*	*Av. Variation % Zn*	*g. of Brass Deposited*
0	27.8		0.2021
0	27.2		0.2107
5.6	29.3		0.2150
5.6	29.6	+2.0	0.2144
10.4	28.2		0.1967
10.4	28.6	+0.9	0.1931
50.4	27.8		0.2264
50.4	28.6	+0.7	0.2177
250	29.2		0.2023
250	28.8	+1.5	0.2003

There is a very small increase in the per cent of zinc after adding nickel in brass deposited from the above bath as shown

in Table 8. The increase in zinc in this experiment was not uniform.

There was no increase in the weight of brass deposited after adding nickel to the bath. Apparently nickel does not affect hydrogen deposition in the way arsenic does.

PHENOL

Experiment IX

To determine the effect of phenol in the plating bath on the zinc content of the deposited brass.

TABLE 9

Phenol Added g./L.	*% Zn Found in the Plate*
Bath 17	
0	38.0
3	34.4
Bath 18	
0	32.6
3	29.0

Table 9 shows that phenol, the well-known brass plating addition agent, decreases the per cent of zinc in the deposited brass.

THROWING POWER

Experiment X

To determine the influence of Throwing Power upon the copper: zinc ratio of the bath.

Plating was done in the plant still bath whose composition was as follows:

		Oz/Gal.
Uncombined	NaCN	0.81
	$Zn(CN)_2$	1.39
	CuCN	2.72
	pH	12.1

The parts plated resembled an ordinary tea cup.

TABLE 10

Per Cent Zinc	
Outside	*Inside*
30.7	45.7
31.7	47.7
30.0	44.0
29.6	45.0

The brass deposit on the outside of the cup was of a normal canary yellow; the inside was red. (Brass of 40 per cent zinc or over is red, as well as brass of 20 per cent zinc or under.)

This experiment indirectly supports the theory that an increase in current density decreases the per cent of zinc in the deposited brass, because the current density is greater on the outside of the cup than on the inside.

AGITATION

Experiment XI

Effect of agitation on the per cent of zinc in the plate and the weight of brass deposited.

TABLE 11

Agitation	*No Agitation*
% Zn	*% Zn*
31.8	31.8
31.4	30.9
Grams of Brass/sq. ft.	
2.92	2.02

Table 11 illustrates in the first part that agitation of the plating bath does not change the copper: zinc ratio. The second part shows that agitation increases the weight of brass deposited in the same length of time as would be expected.

CURRENT DENSITY

Experiment XII

To determine the effect of current density upon brass plating characteristics. Basic bath No. 1 was employed.

TABLE 12

Amp/sq.ft.	*% Zn Deposited*	*Av. Variation % Zn*	*% Cathodic Efficiency*	*Volts*
4.5	28.8		52.8	2.5–2.5
4.5	29.0	+1.4	51.2	2.6–2.6
9.0	27.8		32.3	3.0–3.1
9.0	27.2		33.5	3.1–3.15
13.5	27.3		23.7	3.5–3.5
13.5	27.5	−0.1	23.1	3.4–3.45

Increasing the current density increases the per cent of copper in the deposited brass slightly in Experiment IX.

Increasing the current density decreases the cathodic efficiency.

TEMPERATURE

Experiment XIII

To determine the effect of bath temperature upon the per cent of zinc and the weight of brass deposited.

Base baths No. 2 and No. 1A were employed. The plating time was ten minutes.

TABLE 13

T°C	*g. Brass Deposited*	*% Zn Deposited*	*Decrease in % Zn*
	Bath No. 2		
26.7	0.12	30.7	
32.2	0.20	25.7	5.0
37.8	0.29	22.3	8.4
	Bath No. 1A		
26.7	0.24	25.9	
32.2	0.32	22.4	3.5
37.8	0.39	19.3	6.6

Table 13 illustrates that increasing the temperature of the bath decreases the per cent of zinc in the deposited brass. This table also shows that increasing the temperature increases the weight of brass plated per faraday; that is, increases the cathodic efficiency.

PER CENT Zn IN EACH LAYER

Experiment XIV

To determine the effect of plating time upon the zinc content of the deposited brass.

This experiment with Bath 16A was conducted as follows: A batch of washers was plated in the factory for (7 min.), then samples for analysis were removed. The plating was then continued on the remaining washers for seven minutes more. Samples were removed at this time (14 min.) for analysis. The plating was then continued on the remaining washers for seven minute intervals until completed.

TABLE 14

Bath 16A				Bath 16B			
Min. Plated	*Thickness in Inches*	*% Zn*	*Computed % of Zn in each Layer*	*Min. Plated*	*Thickness in Inches*	*% Zn*	*Computed % of Zn in each Layer*
7	.000,028	27.0	27.0	7	.000,021	24.7	24.7
14	.000,057	25.6	24.2	14	.000,050	23.9	23.1
21	.000,094	25.4	25.0	21	.000,081	23.8	23.6
28	.000,131	24.8	23.0	28	.000,109	23.7	23.4
35	.000,155	25.0	25.8	35	.000,138	23.8	24.2

Table 14 shows that the layer of brass deposited adjacent to the steel is slightly higher in zinc than subsequent layers.

Experiment XV

To test the adhesion of plant plated brass of varying zinc content upon rubber stock B.

These samples were plated in the plant still bath No. 18, making suitable adjustments to obtain the per cent of zinc indicated.

Adhesion is expressed as "G" for good; "F" for fair; "P" for poor; and "O" for zero.

The following rubber stocks are designated for the purpose mentioned:

Rubber Stock	*Purpose*
A, G,	Solid Tire
B, E, H, K	Motor Support
C	Shackle bolt
D	Rubber valve
F	Hard Rubber

The "fair" adhesion obtained on the brass plate containing 28.6 per cent zinc is probably due to "deterioration" of rubber stock in adhesion capacity.

Table 15 (see following page) illustrates that satisfactory adhesion to rubber stock B is obtained with brass plate varying between 24.6 and 33.6 per cent of zinc. Brass plate containing less, or more, zinc gives only uncertain adhesion.

TABLE 15

% Zn in Plate	*Adhesion to Stock B*	*Number of Tests*	*% Zn in Plate*	*Adhesion to Stock B*	*Number of Tests*
22	F	1	29.1	G	3
22.4	P	1	29.4	G	3
23.0	F	1	30.0	G	4
23.5	P	1	30.1	G	3
24.4	F	1	30.3	G	2
24.4	G	1	31.0	G	1
24.6	G	1	31.4	G	3
25.5	G	4	31.6	G	1
25.8	G	1	31.8	G	2
26.0	G	1	32.0	G	1
26.3	G	2	33.0	G	1
27.0	G	2	33.4	G	1
27.2	G	2	33.6	G	2
27.4	G	1	34.0	G	1
27.7	G	1	34.0	F	1
28.0	G	4	34.8	F	1
28.3	G	3	35.7	G	1
28.5	G	2	36.2	F	1
28.6	G	1	36.7	G	1
28.6	F	1	37.3	G	1
28.7	G	2	39.8	F	1

SOLID BRASS

In order to vulcanize rubber to the same brass strip several different times, solid brass strips were cast, some of varying copper: zinc ratio, others of varying percentage of impurities. These bars were 8 inches long. They were split longitudinally. The freshly cut surface was polished with "O" emery paper before curing the rubber. This gave two strips of the same composition which were useful for the purpose of checking.

COPPER: ZINC RATIO

Experiment XVI

To determine the adhesion of two different rubber stocks to solid brasses of different zinc content.

TABLE 16

% Zn	Rubber Stock A	Rubber Stock H	% Zn	Rubber Stock A	Rubber Stock H
15	O	....	30.0	G	G
15	O	....	30.0	G	G
18.3	O	P	33.6	G	G
18.3	O	O	33.6	G	G
20.8	G	G	34.0	....	G
20.8	G	G	34.0	....	G
21.8	G	G	35.0	P	F
21.8	G	G	35.0	G	F
23.9	G	G	36.0	G	P
23.9	G	G	36.0	G	....
24.9	G	G	39.4	P	O
24.9	G	G	39.4	P	....
25	G	F	47.5	....	O
25	G	G			
27.5	G	G			
27.5	G	G			

The solid tire stock A and the motor support stock H in Table 16 have their best adhesion to solid brasses of 20.8 to 35 per cent zinc.

LEAD AND NICKEL IMPURITY

Experiment XVII

To test the adhesion of various rubber stocks to solid brasses containing a third alloy.

TABLE 17

	% Alloy	B	C	A	D	E	F^1	F^2
				Lead				
0	Pb	G	G	F	F	G	O	F
0	"	G	G	G	G	G	O	F
1.0	"	G	F	P	G	G	O	F
1.0	"	G	G	G	G	G	O	F
10.0	"	O	F	P	G	P	P	F
10.0	"	G	F	G	P	F	....	....

		Nickel					
.055	Ni	G	P	G	F	G	P
.005	"	G	P	F	G	G	P
.07	"	G	P	G	F	G	P
.07	"	G	P	G	P	G	P
.043	"	F	F	G	G	G	O
.043	"	F	F	G	G	G	O
5.16	"	F	O	O	G	G	O
5.16	"	G	O	O	G	G	O
14.72	"	G	O	O	G	G	O
14.72	"	G	O	O	G	G	O

Stock F^1 was tested without cementing the brass.

Stock F^2 was used with cement.

Table 17 shows that lead and nickel in small amounts alloyed in brass affect adhesion to the above stocks very little. Large amounts decrease adhesion to some stocks.

ARSENIC AND TIN IMPURITY

Experiment XVIII

To test the adhesion of various rubber stocks to solid brasses containing a third alloy.

TABLE 18

% Alloy		*B*	*C*	*A*	*D*	*E*	*F*[1]	*F*
		Arsenic						
0	AS	F	F	G	G	G	O	O
0	"	F	F	F	F	G	O	O
.003	"	G	G	F	F	G	O	P
.003	"	G	F	F	F	G	O	F
.013	"	G	P	F	G	G	O	G
.013	"	G	G	G	G	G	O	F
.075	"	G	F	G	G	F	O	F
.075	"	G	G	G	G	G	O	F
1.00	"	G	G	G	G	G	P	F
1.00	"	G	G	F	G	G	P	F

		Tin						
0	Sn	G	G	G	G	G	O	P
0	"	G	G	G	G	G	O	P
0.1	"	G	G	P	G	F	O	F
0.1	"	G	G	G	G	F	P	F
1.0	"	G	P	P	G	G	O	P
1.0	"	G	O	G	G	....	....	....
10.0	"	O	O	O	P	O	O	P
10.0	"	P	O	P	P	O	P	G

Again F^1 is without cement and F^2 is with cement. The first two strips of F^1 and F^2 were cleaned in nitric acid. This was probably the reason for no adhesion.

Table 18 shows that tin in small amounts alloyed in brass affects adhesion to the above rubber stocks very little. Larger amounts of tin decrease adhesion.

Arsenic improves the adhesion of the shackle bolt stock "C" and does not decrease the adhesion to any of the stocks.

TIME OF CURE

Experiment XIX

To determine how adhesion is affected by the extent of vulcanization of the rubber stock to solid brasses of different zinc contents.

In this experiment solid brass strips were cured for twenty minutes, and then examined for adhesion (about one-third of the length of the strip was separated in this test). The strip was then cured another twenty minutes, making forty minutes total, and the adhesion examined again. This was repeated a third time, making a total curing time of sixty minutes, all at 150° C.

TABLE 19

% Zn in Brass	*Rubber Stock E*			*Stock K*		
	20′	40′	60′	20′	40′	60′
18.3	P	O	O	G	G	P
20.8	P	O	O	G	G	G
21.8	P	O	O	G	G	G
23.9	P	G	O	G	G	G
24.9	G	G	P	P	G	G
27.5	G	G	G	O	G	G
30.0	G	G	G	O	F	P
33.6	F	P	P	O	P	P
34.3	G	G	G	O	O	O

Rubber stock E in Experiment XIX adheres well only to 23.9 per cent zinc and higher, while stock K adheres well only to 27.5 per cent of zinc and less at forty minutes cure. Good adhesion of stock E at forty minutes cure to 23.9 and 24.9 per cent zinc reverts to bad adhesion upon twenty minutes further curing. Stock K shows this behavior with 18.3 per cent zinc.

HEAT

Experiment XX

To test the adhesion at elevated temperatures.

This test was made by pulling the rubber part way down on the strip, then heating the rubber and strip in a water bath to the temperature mentioned and completely pulling the strip.

TABLE 20

22 C	92 C
Rubber Stock A	
G	G
G	G
G	G
Rubber Stock G	
G	G
G	G

Table 17 shows that rubber still adheres to brass when the temperature is so high that the rubber is weakened.

CONCLUSIONS

It has been shown by the foregoing experiments that the composition of brass may be influenced by several factors. When the following factors are increased in the brass bath, the zinc content of the deposited brass is increased: zinc cyanide, arsenic, nickel, and pH.

When the following factors are increased, the zinc content of the deposited brass decreased: copper cyanide, sodium cyanide, temperature, thickness, and current density.

Higher cathode efficiency is obtained when arsenic is added to the bath. Lower cathode efficiency results when sodium cyanide is added to the bath.

Adhesion of the rubber stock studied is optimum for plated brass of 24.4 to 33.6 per cent zinc, and for solid brass of 20.8 to 34.0 per cent zinc.

Small amounts of lead, nickel, arsenic and tin, when alloyed with solid brass, have slight influence upon rubber adhesion. Arsenic up to one per cent does not decrease adhesion. Larger amounts of the other three alloys do injure adhesion to some rubber stocks.

Heat below curing temperature does not weaken rubber adhesion to brass. Not only do different rubber stocks require brass of different zinc content for good adhesion, but sometimes the rubber is in such a condition that complete vulcanization time and temperature result in the disappearance of adhesion.

Pure alpha brass adheres best to most rubber stocks.

Credit is cheerfully given to Mr. T. A. O'Neil and Mr. E. Friedl of the Firestone Steel Products Laboratory for performing some of the experiments reported here. Gratitude is also expressed to Mr. W. A. Baker, President of Firestone Steel Products and to Mr. E. B. Babcock, Chief Chemist of Firestone Tire & Rubber Company, for permission to publish this report. (Applause)

MR. SODERBERG: I want to ask a question about anode efficiencies in these baths. What anode current densities can you apply under various conditions? Mainly anode efficiencies are dependent upon the cyanide content and the current density.

DR. COATS: The question may not have been understood in the back of the room. As I understood it, it was, what anode efficiencies do we obtain. I have no experiments to illustrate that, but if the current density on the cast anode is not greater

than four and one-half amperes per square foot and the uncombined cyanide is one ounce per gallon, the anodes will dissolve at the proper rate to replenish the bath, which means it is very close to one hundred per cent anodic efficiency. I think the other part of the question was the relationship of sodium cyanide to the anodic efficiency, and I answered that in stating that the uncombined sodium cyanide, as I expressed it is one ounce per gallon — I showed some slides in which it was different — more or less than that amount gave different results on the cathode, but, unfortunately, I did not have the results on the anode.

MR. R. G. SEYL (Chicago, Illinois): I was wondering if there was any physical explanation of the adhesion of the rubber to the brass.

DR. COATS: You may certainly ask the question, but I can not answer it. I do not know. I have a lot of theories, but I do not have any answer to it.

DR. BLUM: In that connection, may we ask what is the order of adhesion to brass compared with that to copper or nickel or other metals? In other words, is brass the only coating you could use to get any decent adhesion?

DR. COATS: No, it is not. Practically it is, but the reason that it is practically is because the rubber companies want to send the brass plating to Detroit in one container and the rubber in another and obtain adhesion when they reach Detroit. We used to cure for two hours and now we cure for twenty minutes. With those short curing times, the plating has to be very good. We can get adhesion to copper and we used to do that when we cured an hour. We can not get adhesion satisfactorily in a short length of time for those stocks if we use the rapid accelerator. There is one exception to that. Nickel-zinc, such as is plated from a so-called black nickel bath, will adhere satisfactorily, if plated satisfactorily and protected, to these fast-curing rubber stocks.

Effect *of* Polishing *on* Corrosion Resistance

By WILLIAM M. PHILLIPS

Read at Cleveland 1936 Convention

WE have heard quite a lot on the specifications on the plating of steel, and it occurred to me that, perhaps, a little saw and hatchet investigation might be a good idea. There was only one difficulty about giving this paper tonight, and that was we have not used the saw and hatchet long enough to clinch the conclusions. What we have tried to do in this experiment has been to find out what the effect of polishing is on the resistance we get to corrosion on plates of copper and nickel, and we are later going to determine something of the same kind on cadmium and zinc.

The object of this experiment which I am going to outline was to try the effect of different types of polishing under specification plates of different metals. The wheels used were of felt to avoid any discrepancies in wheel surface and were set up using Hyde Glue. The abrasives were of the artificial aluminous oxide type, graded in accordance with the accepted standards. Great care was taken to avoid mixing of abrasives grain, and to this end separate containers for both glue and grit were used. The grades were as follows:

Number 1	46
Number 2	80
Number 3	120
Number 4	180
Number 5	240

Number 6 was an open stitched wheel using white chromium compound, buffing after plating with the same wheel and the same composition.

The steel used was cold rolled auto body sheet of good quality. This type of material is used extensively to make auto parts. The plating on one group of panels polished with abrasive from 46 to 240 was as follows: Copper plate from cyanide plating solution to a thickness of .0005 of an inch. This was done at

fifteen amperes per square foot at a temperature of 115 degrees F. This was followed by a .0005 of nickel from a low pH bath. The pH being 2.5. The temperature of the bath was 135 degrees F. On the buffed panel, the same procedure was followed except that one end of each of these panels was chromium plated for two minutes at 200 amperes per square foot at a bath temperature of 120 degrees F. The chromium bath was made up in accordance with the Sargent formula.

The plating on the next group from 46 to 240 grit was nickeled .001 thick from the same tank and under the same conditions as group Number 1. The buffed panels were also plated with .001 of nickel followed by buffing and chromium plating. Other groups were plated with zinc and cadmium. Unfortunately, the latter groups did not fail in salt spray so we can not show you the results of this work.

I know that I am going to be terribly criticized, but we used the salt spray to test these panels. We also have some exposed to the weather in Detroit, and we are curious to see how they will correspond with the test we made in the salt spray. I may say our salt spray equipment is of the Navy type, and it is very carefully baffled. I think a great many of the salt sprays used failed to give uniform results because of improper baffling. You do not get a fog; you get some direct action or air currents. If you hang the piece in one way you get one result, and if you hang it another way you get quite a different result. Our salt spray is very carefully baffled.

Another justification for the salt spray is that last winter we had a cold and icy winter, and a great many of our large cities used tons of salt on the streets to melt the ice and snow. The cars, in driving around through that, got a salt spray test all winter, and they did not stand up very well, I am sorry to say, under those circumstances. So I think the salt spray in this case was justified, at least from the standpoint of the uniform results which we obtained. We put in duplicate panels, and these panels, oddly enough, gave us duplicate results.

The salt spray was operated for eight days, and at the end of that time we thought we could draw a conclusion. I have panels arranged here on the table. It is impossible to present these panels any other way. I am going to ask you gentlemen

to come up after the meeting and draw your own conclusions. That is quite an advantage to me, because I can draw my conclusions first. I can then be out of the way before you fellows disagree with me.

There are a few things that seem to stand out rather clearly:

Number 1: There is very little choice between the copper nickel and the straight nickel.

Number 2: The pieces not polished with any grain stood up better than those that were polished. I am inclined to discount the buffing effect because of the nature of the buffing composition which had a cutting action rather than a planishing action. It is to be noticed under this observation that the parts plated with chromium stood up better than those not chromium plated.

Number 3: The type of failure on the coarse grits, No. 46, 80, and 120, are different from those polished with the fine types, No. 180 and 240. The failure on the coarse polish is of the closely grouped fine pin-hole type while those polished with the fine grades showed failure or rust spots from large holes or pores which has the appearance of coming from holes in the base metal. The background is superior on these panels as compared to those of the coarse grade polish.

Number 4: The most interesting panels are those finished with chromium buffing compound. These panels are so distinctly better that it seems to point to the use of highly finished sheet for the production of parts to be plated.

I want to emphasize particularly the fact that we obtained very good results without using any polishing wheels at all, but just a buffing wheel. That, I think, has a particular bearing on the tests that this Society made in cooperation with the A. S. T. M. and the Bureau, because, after all, they were prepared more or less along that line.

I might mention another thing, just to prevent anybody from forming any wrong conclusions. At the end of three days we had practically no failures on any of these panels that were plated with .001 of either copper or nickel, or nickel only. I think the conclusion might be drawn that it is a good idea, as far as we can, to eliminate all the polishing possible. In other words, get as highly finished steel as we can for the piece we are going to make, and then carry out our fabrication in such a way — the press work, and so on — that we do not have to

polish very much with these coarser grades of emery. I think the whole plating industry has realized this matter without conducting these tests. I think we have been going in that direction steadily, although I see some places still will insist on using very, very coarse wheels and then try to work out those scratches with succeeding wheels. We have done a great deal of work on that. The use of grease wheels, however, with finer grades of emery seems to be the right idea. That seems to be the thing to do.

I think that a very complete investigation probably should be made of this phase of the preparation of steel. I do not claim that this rather short experiment is anything like the last work on it. We ourselves feel enough interest in the results obtained that we want to go further, and the subject may even be important enough to take it up through our Research Committee and perhaps expose panels in different climates so as to get a more comprehensive result.

It appears that the specification of .001 of an inch is certainly still a good specification, but that thing is not injured a bit by this test. But it does appear that we have to go quite a little bit further. I can almost see George Hogaboom smile, because he has been battling with us for quite a while on this base metal business. I believe that we can benefit a great deal if we insist on getting good surface on our pieces that we have to plate.

I had a very interesting talk with the Master Electroplaters' Institute the other day, in which that particular thing was emphasized a great deal. They, as you know, are an association of job platers, and every once in a while they are asked to bid on the plating of something that is not fit to plate, and they do not have the nerve to reject it for fear their competitor will make more money than they do. So they take it on and do the best they can with it, and when it gets out, it is not a good advertisement for the art of electroplating. The stuff does not stand up in spite of the fact that they may have done a very honest job of plating.

I think, gentlemen, considering the lateness of the hour, that I am going to conclude these rather brief remarks in the hope that they will start a discussion on this matter. (Applause)

CHAIRMAN MATHERS: Let us have some questions.

DR. BLUM: Mr. Phillips referred to these tests on steel, and

the very facts which he brings out make us all the more thankful that at least in the first investigation we did not include the effect of the different method of polishing; we did not attempt to put the finish on the steel ourselves because it would have been much more difficult to get appreciable results. In the first investigation we deliberately used one grade of steel — cold rolled steel of a good uniform finish. So we feel the results are at least directly comparable, and these results of Mr. Phillips indicate that they are typical of well-polished or well-finished steel before plating. I feel very gratified about that.

Going just a little bit further than that, I rather hesitate to say this — it may seem to question the specifications — but I think we may as well face the facts. Every once in a while we get hold of a specimen of plated steel that is a whole lot better than it has any business to be by the thickness of the coating. I cite that because it just comes up incidentally with the testing. Whether by accident or otherwise, the people have, perhaps, a very much better finish on that steel before it is plated and have less porosity even than what we would consider typical porosity. I think further study might well be made on that subject.

MR. PHILLIPS: I think Dr. Blum's remark is certainly very, very applicable. Every once in a while our salt spray will show a piece that is all right and our thickness specification will show it all wrong. It does not happen often, but it does happen every once in a while. What I would like to see would be to have the plating industry get a good surface and then put on the full specification. I think we would certainly get very, very much better quality than we are getting now.

CHAIRMAN MATHERS: Who has another question?

DELEGATE P. J. SHEEHAN: I should like to ask Mr. Phillips a question. In using the succeeding grades of grains, is the direction of the rotation of the wheel in each case the same or at a different angle?

MR. PHILLIPS: In this particular case, Mr. Sheehan, we did not use succeeding grades. We had just one grade on each piece of steel, so we did not come into that problem. That would necessitate another group of panels where you polish from one to the other. We did not do that.

DELEGATE R. M. WAGNER (Anderson, Indiana): We have done quite a bit of work trying to find the cause of salt spray

failures on some steel work, bumper guards in particular, and have found invariably that regardless of the thickness, failures occur in nicks or imperfections in the base metal. We have had innumerable instances of a piece standing up quite a length of time with, perhaps, half the specified thickness of the metal on the plate, whereas other pieces failed with full thickness of plate on them, due entirely to just having a nick or some imperfection underneath the plate.

MR. PHILLIPS: That is entirely true, Mr. Wagner, but the point is this: If you can get smooth stock to start with and then conduct the manufacturing operation so that you do not get the nicks, you will not have them. It is quite a hard job to do that in some cases. Your bumper guard is a heavy stamping, and it is more or less likely to be handled rather rapidly and be thrown into tote pans rather than laid down in the tote pan, and that may have something to do with it.

I went into one shop in the East where they do not happen to do any polishing at all. They do some buffing. They operate entirely on nice smooth sheets. In their stamping department they put the things on racks. They do not have a tote pan in the place. As soon as it comes off the press they hang it on a rack. When they are all through, they do a little preliminary work on it with a wheel, something like the one I have mentioned here, but it is not a polishing operation. They go over the plating and buff it. They are really saving money. It can be done. You have to have good die work and good metal.

DELEGATE WAGNER: At the same time, we have a certain finish specification to meet, and we always find a certain amount of orange-peel effect on the steel which we are going to have to cover by nickel buff or polishing. If we nickel buff, we are removing that much nickel. It still seems to me it is advantageous to remove the defects before we plate rather than try to cover them up afterward, because they will surely crop out.

MR. PHILLIPS: Mr. Wagner, I am not suggesting that you cover them up afterward. I am merely suggesting that I hope you do not get them to start with.

MR. HOGABOOM: You hit the nail on the head then. If you do not get them when you start, you do not have to cover them up. It is not a question of the surface; it is a question of what is under the surface. Take the modern method of making strip

stock with a hot roller. During the hot rolling of steel the oxide film which forms on the surface is rolled in and it is kept on being rolled in and the hot body of the stock is filled mostly with oxides. Then they pickle. They do not pickle the inside of the stock; they pickle only the outside. Then it is cold rolled and given a surface finish. Just as soon as you break through that surface finish, you get those oxides, and when you grind it with a coarse wheel, you break through that surface finish and get your oxides and your typical pitting of what you have here, where it comes in the large pits all though. But where you have your rolled surface and the surface is then plated just from the roll, of course you do not get it. That is what Mr. Wagner is getting. In some stock it is rolled and it does not break through, but if you do break through that, then you get the oxide that is all inside. Take a cross-section of steel and examine what you are plating, not on the surface but on the inside, and you will see a difference.

CHAIRMAN MATHERS: Who has another question?

MR. COSGROVE: I think there should be more cooperation. At least, there is a chance for the plater to cooperate with the punch press departments in his factory. We find in our plant that by chasing the thing back to the raw material and then chrome plating the dies, buffing them up bright so that there are no die marks getting on the work, and starting out with a good grade of steel, we are able to cut down a good many of the parts where there is only one Tampico wheel operation. There are no die marks on the work and we really find it is cheaper in the end.

MR. HOGABOOM: Recently I saw a very interesting method of handling stock, as Mr. Cosgrove has said. They are making such things as cigarette cases, cutting and blanking and not putting the design in, sending that blank to the plating room and plating it with a copper or tin-copper alloy, and then sending it back to the press room and using a die that is highly polished. The metal plated on the steel acts as a lubricant. The smooth die gives a perfect surface and the deposited metal is burnished. They just trim it, put it through, and color it up on a soft buff. Then they send it to the plating room and nickel plate it or chromium plate it, and do no other work at all. That is the ideal way of handling small goods, at least.

The 1937 Convention Committee

on behalf of the

New York City Branch

Extends Best Wishes
for a Happy and Prosperous New Year
to the Members and Friends of the A. E. S.

❖

Traditionally this is the time of the year when all good men resolve to be bigger and better. Six months ago the 1937 Convention Committee dedicated itself to the following resolutions:

1. To make the Silver Jubilee memorable.
2. To make the Educational Sessions a living force to meet the practical needs of the A. E. S. membership.
3. To make visitors to the Convention comfortable, happy, and to entertain them in our best New York manner.
4. To make new friendships and renew the old.

In accordance with the ancient and honorable tradition of the season we rededicate ourselves to these resolutions.

The 1937 Convention Committee,
Louis H. Cates,
Publicity Chairman

Fitting *the* Lacquer *to the* Job

Be Sure the Kind You Use Was Developed For Both the Metal To Be Furnished and Its Application

By GUSTAVE KLINKENSTEIN

Vice-President and Technical Director
Maas and Waldstein Company
Newark, New Jersey

IT would be fine for both the metal finisher and the lacquer manufacturer if there were a Universal Lacquer —a lacquer that could be used for finishing any metal regardless of its nature or the purpose for which it is to be used.

Such a lacquer would greatly simplify both our jobs. But unfortunately there isn't such a thing. Maybe somebody will invent one sometime, but at present it is as much a chemical myth as the Universal Solvent or the Elixir of Life.

True, one clear lacquer looks pretty much like another. Even experts cannot always tell them apart without careful tests. But chemically they may be as different as potassium cyanide and baking soda, which also look alike in aqueous solution. And it may be just as harmful to use the wrong lacquer on a given product as to use the wrong chemical in the plating bath.

A good many electro-platers, apparently, haven't as yet discovered this fact. At least, if they have a lacquering job to do, they will use any clear lacquer they may happen to have handy. Sometimes all goes well, but sooner or later this practice is going to spell MUCH TROUBLE.

Let us take the case of lacquering solid brass. For many applications of this metal, the lacquering requirements are not very rigid. Quite a number of lacquers serve to protect solid brass products that are used indoors. But if the product is to go out of doors, then the lacquer employed must be designed to withstand exposure to the weather, or the film will be quickly destroyed and a sorry-looking object will be the result.

Or suppose our brass product is one of the simplest ones known to the industry — the ferrule at the end of a common wooden pencil. Will any old lacquer do here? Most decidedly not, for the little ferrule holds a rubber eraser, and the rubber eraser contains sulphur, and if the lacquer used is not specially

designed to resist the action of this active chemical element, the pencil manufacturer who uses the ferrule is going to have a large part of his output back on his hands.

Again, suppose the brass product is a name plate. Use only a lacquer developed to withstand shearing, stamping, and forming, or your percentage of rejects is going to be something alarming.

Of course, to many electro-platers, these facts are elementary. You would not find any of them making any of the mistakes I have just mentioned. No, but some of them will take a lacquer that works well on solid brass and use it on a brass-plated job.

This is a natural thing to do, for, apparently, one is dealing with surfaces having the same chemical composition in both cases. Actually, however, this is not true, for the brass-plated job, no matter how thoroughly cleaned, will contain traces of the plating-bath chemicals; and unless the lacquer is specially designed to resist destruction by these chemicals, the finish will be ruined by spotting.

It is equally natural to use on copper a lacquer that is suited to brass, but it is equally dangerous— because a lacquer which will hold its color on brass may discolor on copper,— and on bronze too for that matter. From the lacquer standpoint, brass, copper, and bronze are three distinctly different metals and require different kinds of finishes.

Silver is another metal that requires a distinctive type of lacquer. Here the requirements are for a film that is so thin and transparent that it is invisible, so unreactive to the metal that it will not cause darkening, and so protective that the original finish will be retained indefinitely. Obviously, no ordinary grade of lacquer will be suitable for silver products.

Then we have a group of metals, generally known as the "oily" metals — aluminum, cadmium, and zinc. These metals are not oily, but they do tend to form greasy metallic soaps with many common lacquer bases, and this action gives them their reputation. As a group, and individually, they present many difficulties to the lacquer maker. Aluminum lacquers must not only be non-soap forming, but must also adhere in spite of surface oxidation. Cadmium lacquers must solve a particularly difficult adhesion problem. With zinc, there is

not only the problem of adhesion but also one of darkening under the lacquer film. It has required many years of research to produce lacquers suitable for use on each of these metals.

Chromium is another troublesome metal. In fact, in order to finish chromium properly we should not use an air-drying lacquer but should bake on a clear priming coat before applying the final finish.

Similar examples could be multiplied indefinitely. In fact, for the lacquer maker, practically every metal and every alloy possesses special characteristics that require individual treatment.

The lacquer maker must also consider the service conditions of the lacquered product and the possibilities of its exposure to rough usage, humidity and moisture, high and low temperatures, acids and alkalies, household cleaners, and a variety of other destructive agencies, including the teeth and tongues of human infants. Lacquers can be developed to meet practically every condition that can be foreseen; but if a lacquer is incorrectly selected, the results may be anything but satisfactory.

When we introduce colors into a lacquer, a new series of complications arises. Every pigment has its own peculiar chemical and physical properties, and these must be considered in formulating the lacquer and in specifying its uses, or else the finished product will suffer.

Finally, the process by which the lacquered product is to be made, the facilities and technical skill available, and many other manufacturing details must be taken into account. Lacquer is not something that is merely applied to a finished product; it forms an important part of the production process, and unless properly selected in all its details for the particular work in hand, it may send production costs skyward.

Now I know that many users of lacquers believe that, for commercial reasons, lacquer makers purposely over-emphasize the complexities of their products and create mysteries where none exist. But such is not the case. The lacquer maker, like every other manufacturer, dislikes special products. He would much prefer to standardize on a limited number of items and

produce them in quantity for widely varying applications. But until he discovers the Perfect lacquer base, pigment, and solvent, he cannot simplify his procedure.

Nor are there any mysteries in the lacquer business. It does, however, represent a very complex and abstruse chapter in the science of chemistry, which few can master unless they have devoted many years to it; and those who wish to spend their time in other pursuits will be wise to leave the matter in the hands of specialists.

The moral of all this is to trust your lacquer manufacturer. Let him work with you; look to him for advice on your finishing problems; consult him before you start turning out a new product; inform him of every change in your manufacturing process or in the uses of your products; summon him whenever trouble arises; and don't think that any kind of lacquer can be used on any kind of product.

Providence Attleboro Branch

In an effort to stimulate interest in the activities of the Providence-Attleboro Branch the regular meeting will be held at the

NARRAGANSETT HOTEL, ROOM C

on Friday Evening, January 15, 1937

Mr. William Cahill will speak on Cleaners.

The Executive Secretary of the A. E. S., W. J. R. Kennedy will be present.

Every member of the Branch is invited to make a special effort to come to this meeting.

JOHN ANDREWS,
Secretary

DETROIT REX PRODUCTS COMPANY CONFERENCE

A conference of the Regional Sales Managers of Detroit Rex Products Co., 13005 Hillview Ave., Detroit, Mich., is being held at the Detroit Office of the company December 16 to 20th inclusive. Plans are being formulated for doubling the sale of Degreasers, Solvents, and Alkali Cleaning Compounds during the ensuing year.

NORTHWESTERN PLATING COMPANY BUYS NEW BELKE MULTI-UNIT INSTALLATION

With business definitely on the upgrade the Northwestern Plating Works of Chicago, Illinois, have found it necessary to increase their plant facilities by the addition of a New Belke multi-unit plater, made by the Belke Manufacturing Company of 947 N. Cicero Avenue, Chicago, Illinois. This new unit offers many interesting features that speed up the work and reduce plating costs to a new low. It includes one utility tank, a special three barrel plating tank and two rinsing tanks.

New Flexible Cathode Contact Cables Eliminate Danglers.

To insure the highest efficiency of current usage, from hangers to cathode contact cable in the plating tank the oversize bronze conductors are covered with heavy sheet of rubber. Not only does this assure the greatest efficiency of current usage but it also gives more plating per ampere. In this way practically none of the current entering the barrel is lost.

The cathode contact cables, which are on each end of the barrel are constructed of heavy, flexible copper wire, the bodies of which are thickly insulated, and have heavy chromium plated steel knobs on the ends. These press down on the work to provide good contact and uniform current distribution. This exclusive Belke feature eliminates danglers and prevents absorption of the metal in the solution; thereby speeding up plating.

Heavy Work of Lifting Barrels Done by Overhead Conveyer

An electric hoist mounted above the unit lifts the plating barrels and carries them back and forth for the different operations. This new innovation practically eliminates all the manual labor heretofore associated with electric plating.

Overhead Conveyer Even Utilized to do Rinsing Job

The work is inserted into the plating barrel while it is resting on the loading or utility stand. The overhead hoist then lifts the plating barrel and places it into the plating tank. After the work has been plated the hoist carries the barrel to the third tank. Here the work rests directly above the first rinsing tray, two doors are opened in the barrel and the work automatically falls into the rinsing tray. The conveyer then carries the plating barrel back to the loading stand where it is ready to be reloaded.

The conveyer is returned to the first rinsing tray which is hinged to the tank on the small end, a hook is attached to the wide end of the tray and the work is given a vigorous slushing in cold, running water. The hoist is then lifted high, and as the tray comes up the work automatically slides through the chute into the second rinsing tray, the hoist hook is attached and the slushing operation is repeated in the last tank which contains hot running water. This gives the work a thorough rinsing. The hoist is then lifted and the work slides out of the tray on each side of an inverted V-shaped partition into two baskets at the same time. This last hot water bath also facilitates drying to a great degree.

Here and There

The Bridgeport Branch meeting was held on Friday Evening, December 4, 1936. As we entered the Stratfield Hotel where the platers from this section of the Nutmeg State get together, everything looked familiar, for here in 1935 the annual A. E. S. Convention was held. The attendance at this particular meeting was very good and a fine feeling of cooperation and good will prevailed.

President Bridgett lost no time in getting the business of the evening transacted, most of which was devoted to the proposed forming of a Branch in New Haven. It looks as though the Elm City members will have their own Branch before long, by mutual consent. At the close of the business session, W. E. Bancroft of Pratt & Whitney Co., Hartford, read a most interesting and instructive paper on Chromium Plating Dies and Tools. The talk was well illustrated and samples of Mr. Bancroft's work were passed around for inspection.

Walter R. Meyer introduced the speaker. Bridgeport Branch is fortunate in having men like Mr. Meyer. Walter is not only able and willing but is extremely popular at convention sessions and branch meetings alike. Our best wishes will go with him as he crosses the ocean to be one of the speakers at the International Electroplaters' Meetings in London, March, 1937.

Ray O'Connor's business is expanding so that he is moving from his present location to another part of the city.

We don't know whether Ernest Bancroft is available as a speaker before other branches or not but his paper is a valuable contribution and contains a great deal of information to those plating tools, dies, gauges, etc. We do not wish to interfere with the affairs of the New England Banquet at Boston, but a paper like this should go over big if the Boston Committee and Mr. Bancroft could get together.

Charlie Costello, the live wire Secretary of Bridgeport Branch, had a busy evening. Every Branch visited so far has been blessed with a good Secretary. We have one or two Branches, however, where this officer has fallen down on the job with the result that the Branch has ceased to function. Moral: a good Secretary—a real wide awake Branch. Of course, if the members are lax in attending the meetings and let their dues lapse, even a faithful Secretary sometimes loses courage.

Our best wishes to President Chase and Secretary John Andrews as they endeavor to revive interest in the Providence-Attleboro Branch. We are counting on the older as well as the younger members of the Branch to give them encouragement and support.

One of our good friends, Mr. R. S. Leather, of the Lea Manufacturing Co., Waterbury, Conn., is making a collection of photos taken at A. E. S. Conventions, and is framing them. Many of these taken previous to 1930 are not included. If anyone has group photographs that are not now being used, Mr. Leather would like to receive them. If sent to him in time they will be exhibited at the New York Convention.

Bob says you won't have to dust the cobwebs off. Get in touch with him; he'll see that they get fixed up.

Thanks to so many of our members who wrote us in such complimentary terms about the December issue of the REVIEW. We wouldn't be human if we didn't appreciate these letters.

Boston Branch

of the

American Electro-Platers' Society

will hold its annual

EDUCATIONAL SESSION

and

BANQUET

MARCH 6, 1937

at the

BRADFORD HOTEL, BOSTON

Registration will be $2.00 per person

KEEP THIS DATE OPEN FOR THE BEST TIME THIS BRANCH WILL EVER HOLD; SATURDAY MARCH 6, 1937

The Educational Session will begin at 2 P. M. One need not be a member to attend the session, the latest developments in electro-plating and metal finishing will be read by accepted authorities on these subjects.

The educational session is not complete as yet. So far we are assured of two speakers: Mr. W. M. Phillips of the General Motors Research Staff will show the Pictorial Projectoscope, showing plating solutions at work on the screen. His subject will be "The Actual X-Ray of Plating Baths."

Mr. Ben McGar, Research Chemist of the Chase Brass Co., his subject will be "New Developments in Copper-Alloys."

The Banquet will start at 7 P.M. sharp.

The Banquet Committee has planned a first class affair — a good entertainment—Music—and Dancing, all carefully arranged to please the ladies.

You owe it to yourself to take advantage of this afternoon and evening of Education and enjoyment of the best that is offered you among friends. So come, bring your wife and friends.

The Projectoscope will be a revelation to you and a great source of interest to us all.

We will be looking for you, waiting to greet you in the good old fashioned way.

Saturday, March 6, 1937, at the Bradford Hotel, Boston, Mass.

Registration Tickets may be obtained in advance from the Secretary, Andrew W. Garrett, 100 King St., Dorchester, Mass.

Very Truly Yours,

BERT W. SAGE,

Publicity Committee

FIRST INTERNATIONAL ELECTRODEPOSITION CONFERENCE

LONDON, 3rd and 4th MARCH, 1937.

Organized by the
Electrodepositors' Technical Society

President: E. A. OLLARD, A.I.C., A.R.C.S.
Hon. Treasurer: F. L. JAMES

PROVISIONAL PROGRAMME

Wednesday, 3rd March

Opening Ceremony at British Industries House, followed by Luncheon
First Session (Afternoon):
"ELECTRODEPOSITION PRACTICE ABROAD."
Second Session (Evening):
"ELECTRODEPOSITION OF BASE METALS."

Thursday, 4th March

Third Session (Morning):
"THE PROPERTIES OF ELECTRODEPOSITS."
Fourth Session (Afternoon):
"ELECTRODEPOSITION OF PRECIOUS METALS."
Reception and Dinner

Papers have been accepted from Belgium, Czechoslovakia, France, Germany, Holland, Russia, Switzerland, and the United States of America.

THIS PROGRAMME IS SUBJECT TO REVISION

All enquiries should be addressed to the Hon. Conference Secretary:
H. WYNNE-WILLIAMS,
12A, Raleigh House, Larkhall Estate, London, S.W.8.
Telephone: MACAULAY 2162.

List of American Papers

1. **The Crystal Structure of Copper Electrodeposits**
   Arthur Phillips, Prof. Metallurgy, Yale University;
   Walter Meyer, Electrochemist, General Electric Co., Bridgeport, Conn.
2. **Developments in the Electrodeposition of Platinum Metals**
   K. Schumpelt, Ph.D., Chief Electrochemist, Baker and Co., Inc., Newark, N. J.
3. **The Cyanide-Cadmium Plating Solutions**
   Gustaf Soderberg, Ph.D., Chief Chemist, Udylite Co., Detroit, Mich.
4. **Methods of Determining Thickness of Electrogalvanized Coatings**
   A. K. Graham, Ph.D., Assistant Prof. Electrochemistry, Univ. of Penn.
5. **Studies Evaluating the Brightness of Electrodeposits**
   B. Egeberg, Ph.D., Chief Metallurgist, International Silver Co.;
   N. Promisel, Electrochemist, International Silver Co., Meriden, Conn.
6. **A Resume of Silver Plating**
   Frank C. Mesle, Research Engineer, Oneida, Ltd., Oneida, N. Y.
7. **Electroplating — American Practice**
   George B. Hogaboom, Engineer, Hanson-Van Winkle-Munning Co., Matawan, N. J.

Membership Campaign

December, 1936

Branch	Elected	Reinstated
Detroit	7	5
Boston	6	
Bridgeport	6	1
Grand Rapids	5	
Pittsburgh	3	
Springfield	3	
Binghamton-Elmira	2	
Milwaukee	2	
Newark	2	4
Philadelphia	2	
Toledo	2	1
Anderson	1	
Baltimore-Washington	1	
Cleveland	1	
Dayton	1	
Hartford	1	
Los Angeles	1	
Toronto	1	
Cincinnati		1
Chicago		
Montreal		
New York		
Providence		
Rochester		
San Francisco		
St. Louis		
Waterbury		

The Abstract Section

JAMES W. HANLON, *Chairman, Program and Educational Committee*

METAL CLEANING AND FINISHING

Throwing Power and Current Distribution in Plating Baths—Part III. By LEONARD C. FLOWERS. November, 1936—There is a great deal of published matter in regard to throwing power in various solutions. The author comments that although many of the findings are inconclusive, or even contradictory, the purpose of his article is served by a general summary of reported data. References to original papers are given. Observations under various experimental conditions are recorded for acid and cyanide copper, high and low pH nickel, chromium (chromic acid sulphate), acid and cyanide zinc, cadmium cyanide and alkaline tin solutions. The necessity of further research is stressed. E. T. SHEEHAN

Electroplating on Lead-Antimony Alloys. By WALTER R. MEYER. November, 1936—The physical characteristics of lead-antimony alloys are discussed in relationship to subsequent finishing operations. Sand bobbing is employed for the polishing. High peripheral speeds and wheel pressure must be avoided. Cathodic and anodic electrocleaning in mind alkaline solutions containing wetting-out agents (sulphonated naphthalenes, etc.) has proved successful. Oxides formed during electro-cleaning are removed in a dip containing 2 oz. per gal. sodium hydroxide. A final hydrochloric acid dip neutralizes any alkali trapped in the pores of the metal, and completes oxide removal. Warm, single nickel salt solutions are recommended for the plating. The chromium plate should not be over three minutes at a 100 amperes per sq. ft. E. T. SHEEHAN

METAL AND ALLOYS ABSTRACTS

Selection, Application and Use of Finishes for Metal. *Steel*, Vol. **98,** March 16, 1936, pp. 32-35—Article discusses subject from users point of view. Outlines basic factors on which selection of finishes depends and then deals with various finishes available, including metallic coatings, organic finishes and surface conversion treatments and testing of organic coatings. PHIL J. RITZENTHALER

Etching Stainless Steel. *Steel*, Vol. **98,** p. 45, May 1936—The usual procedure in etching 18-8 chrome nickel stainless steel requires a solution of ferric chloride or HCl as etching agent. Solution is agitated by air or plates moved in the solution. A 30 minute etch will give .003″ penetration. Plates are washed in running water and then immersed in HNO3 to restore passivity. Etched portion may be filled with enamel if desired. PHIL J. RITZENTHALER

Effect of Variables on Sufuric Pickling. *Better Enameling*, Vol. **7,** January, 1936. By G. L. BRYANT and F. R. PORTER—Tests were made on 2" x 2" steel panels, weighed and then pickled for 10, 20, 30, 40 and 50 minutes in 4%, 6% and 8% by weight of H2SO4 at 140° F, 160°, 170°, 180° F. Panels were dried in alcohol and weighed and loss of weight found. Increase of concentration from 4-6% increased rate, but rise to 8% showed decrease. Increasing pickling period increased weight loss in every case studied, but not rate of reaction. Standard pickling practice in porcelain enamel industry of 6% H2SO4 at 160° F is good practice. PHIL J. RITZENTHALER

Treatment of Galvanized Sheets for Painting. J. L. SCHUELER. *Journal American Zinc Institute*, Vol. **17,** 1936, pp. 93-98—Wherever possible the sheet should be allowed to weather before painting. If that is not possible, etching should be used. When chemical agent is used, it it important that action is not too slow. Avoid acids. A neutral solution of copper sulfate or antemony chloride should be used. Zinc surface should be dry and clean before painting. PHIL J. RITZENTHALER

Nickel Anodes. E. RAUB. *Mitterlungen des Forschunsinstitutes and Probierants für Edelmetalle*, Vol. **10,** July 1936, pp. 37-43—Scarcity and high price of nickel in Germany make use of insoluble anodes desirable, either of carbon, lead or stainless steel. Latter two not good in high chloride baths. Nickel anodes have been made by electrolysis of nickel salts. Of usual impurities, magnesium is harmful as it leads to disintegration of anode. It does not affect deposit. .005 grams/liter of copper produces dark deposits. Iron is stated to be harmful in bath. In larger quantity it produces scaling and spalling. Baths with 0.5-1.0% Fe with respect to nickel are useless. Manganese said to cause poor adhesion. Zinc acts as brightener in small amounts; in larger it causes black streaks. Limit for Zn content is 0.05-0.1% Zn with reference to nickel content. PHIL J. RITZENTHALER

The electrodeposition of manganese from acqueous solutions. II. Sulfate Electrolytes. W. E. BRADT and H. H. OAKS. Trans. *Electrochemical Soc.*, Vol. **71,** Preprint, 1937—Smooth silver white deposit of manganese were obtained from a solution containing 13 oz/gal of manganous sulfate, 10 oz/gal of ammonium sulfate, and 8 oz/gal of ammonium thiocyanate. A combination of soluble manganese anodes and insoluble graphite anodes was used, with a current adjusted for each type of anode. The cathode current density was 250 amp/sq.ft. at a pH from 4 to 5.5 and at room temperature. W. BLUM.

Improved method for electrodepositing alloys. H. KERSTEN and WM. T. YOUNG. *Ind. Eng. Chem.* **28,** 1176 (1936)—The method is illustrated by the deposition of alloys similar to "Permalloy" and containing about 20 per cent of iron and 80 per cent nickel. The solution was kept saturated with nickel formate by passing it through a bed of this salt, and was kept neutral by passing it through calcium carbonate. The required amount of iron was introduced into the bath by continuous small additions of ferrous

sulphate. Alloys of other metals may be similarly deposited, for example on cobalt and nickel, or of gold and nickel. The alloys have the crystal structure of solid solutions, not mixtures, of the two metals. W. BLUM.

The B. N. F. jet-test for local thickness measurement of nickel and other coatings. S. G. CLARKE. *J. Electrodepositors' Tech. Soc.* 12, preprint, Oct. 21, 1926—The jet test is a modification of the dropping test (devised by the same author). In the jet test, an appropriate solution is run, in a fine continuous stream instead of in separate drops, onto the surface to be tested. The flow of liquid is interrupted at intervals to determine whether the coating is penetrated, and the total time of application is measured with a "stop-and-go" watch. The stock solution is kept in a reservoir bottle with a constant level device to maintain a constant head at the jet. The latter is of such size as to deliver about 20 ml per minute. The temperature of the solution during the test must be measured with a thermometer, as the rate of solution varies with temperature.

Any chromium coating over the nickel is first dissolved off in hydrochloric acid containing some dissolved antimony oxide. For nickel coatings the test solution contains:

Solution I

Ferric chloride, $FeCl_3;6H_2O$ ..... 150 g/l
Copper sulphate, $CuSO_4:5H_2O$ ..... 100 g/l
Acetic acid (glacial) $HC_2H_2O_2$ ..... 250 ml/l

This solution produces at the endpoint a copper colored spot on steel or copper, a brown color on brass, and a black color on aluminum or zinc. At room temperature (22° C or 72° F) it requires about 10 seconds to dissolve 0.0001 inch of nickel, less time at higher temperatures and vice versa, as shown on a chart. Bright nickel from one proprietary bath dissolved more rapidly than ordinary nickel, but bright nickel containing cobalt dissolved at the normal rate.

For copper coatings, the test solution contains:

Solution II

Ferric chloride, $FeCl_3:6H_2O$ ..... 150 g/l
Antimony oxide, Sb_2O_3 ..... 20 g/l
Hydrochloric acid (sp.gr. 1.16) ..... 200 ml/l
Acetic acid (glacial) ..... 250 ml/l

For cadmium coatings:

Solution III

Ammonium nitrate, NH_4NO_3 ..... 17.5 g/l
Hydrochloric acid (sp.gr. 1.18) ..... 8.1 ml/l

The above solutions were standardized by testing deposits of which the thickness was determined by stripping or in some cases by metallographic examination. Incidental observations were made upon the unequal distribution of deposits on flat pieces plated under different conditions. The jet method is believed to be accurate within ±15 per cent. W. BLUM.

Business and Social News

BRANCH NEWS

Educational Activities

PITTSBURGH BRANCH

I wish to report that Mr. Edwin S. Gray, one of our oldest members, passed away on November 17, 1936. Mr. Gray had been active in the plating business for over sixty years, and was one of our most active members, until some time ago, when age and sickness prevented him from taking active part in the branch. Mr. Gray was active in church work, especially in Sabbath School and Missions. Many years ago, he established a mission for the Chinese and as many as three thousand attended this mission. He will be missed by these people, who have looked to him for advice and friendship.

Our meeting of last Friday took place in Webster Hall, and as usual, was preceded by a dinner. This is quite the thing, and from the goodly number that attend, it will be continued throughout the winter and spring. We had as our guest speaker, Mr. Oplinger, of the R. & H. Division, E. I. DuPont deNemours & Company. Mr. Oplinger talked on the subject of TIN plating and held the attention of the twenty-five members and their friends until after 10 p.m. Those present voted this to be one of the most interesting meetings we have held, and the Branch gave Mr. Oplinger their thanks for coming to Pittsburgh to speak to them. While the membership committee did not hand in any new applications, the chairman stated that he would have a surprise at the next meeting; he will, for he keeps his word. The officers have planned some good things for the branch at the coming meetings, and hope that the members will continue their interest and attend each meeting. Our next meeting will be held on Friday, January 8th, with a dinner as usual.

S. E. HEDDEN, *Sec'y-Treas.*

BOSTON BRANCH

Boston Branch met Thursday the 3rd at the Manger Hotel with President Mintie in the chair.

Minutes of the previous meeting read and approved, bills read and moved that they be paid, communications read and placed on file.

Three applications read for the second time and elected to membership as follows: James J. Reagan, 213 Princeton St., E. Boston, Mass., Associate; Vincent Campisi, 87 Water St., Watertown, Mass., Active; and Ernest C. Andrews, 148 Wordworth St., E. Boston, Mass., Associate.

Two applications read for the first time and turned over to the board of managers follows: Charles A. Sleicher, 43 Oak Ave., Larchmont, N. Y., Associate and Allyn D. Chabot, P.O. Box 465, Putnam, Conn., Associate.

A report was made on the return of the post cards for the chemistry class. Ten were returned and seventeen returned at the meeting after the report. The following were appointed to make arrangements for the class: Charles O. Hardy, Charles F. Campbell, Arthur J. Mintie, and Harry J. Lack. This committee will meet Saturday. Dr. William Cahill will be the instructor of the class.

We had with us a friend that the

branch always welcomes to our meetings, Mr. Frank Clark. He spoke of the advantage chemistry is to the plater and hoped to see every member join. He paid the fees for three members that could not afford to pay their way and the branch gave him a rising vote of thanks for the interest he has taken in the A. E. S.

Charles F. Campbell also spoke for the class and as always willing to help put anything over he will put two in this class. Dr. William Cahill also spoke and says that he will do all he can to help the members and their friends to know how to take care of their solutions and be able to show the boss that he is able to look out for things when they go wrong and hope that every one would attend every class so as not to miss any of the lessons.

We had with us one of our own members, Mr. Arthur J. Blake, who was the speaker, and he gave a "Demonstration of the Degreasing Machine." It was a very interesting demonstration. He answered all questions for the members. The Branch gave Mr. Blake a rising vote of thanks for his talk.

The meeting adjourned at 11 p.m.

A. W. GARRETT, *Sec'y*

BALTIMORE WASHINGTON BRANCH

On October 24, the Baltimore-Washington Branch had the honor of visiting the Bethanizing Plant at Sparrows Point and saw how the zinc coating was put on wire at a current density up to 1500 amperes per square foot.

The Baltimore-Washington Branch has its Educational Class well under way. I am enclosing a list of the dates when our class meets and the subjects which will be taken up at each class. It was definitely decided at our regular meeting last Saturday, that the Baltimore-Washington Branch will hold its annual banquet at the Rennert Hotel, Cathedral and Saratoga Sts., in Baltimore, on Saturday, February 13th.

The Educational Session will be held in the afternoon at 2:30 in the same hotel. The Banquet will be at 7 o'clock, to which the ladies and friends are invited. After the dinner there will be a dance and entertainment. The price of the tickets will be $2.50 each, including the tax.

IRVIN H. HAHN, *Sec'y.*

CLASS ON THE ANALYSIS OF ELECTROPLATING SOLUTIONS

A laboratory course of 15 lessons on the analysis of electroplating solutions will be given at the Chemistry Building, National Bureau of Standards, beginning on Saturday, November 7th at 7:00 p.m. All interested persons are invited to enroll in this class. The tuition fee for the course is $5.00, payable in installments of $1.00 per month for the first 5 months.

The schedule will be approximately as follows:

November	7—Use of apparatus
November	21—Cleaning and pickling solutions
December	5—Acid copper
December	19—Nickel
January	9—Nickel
January	23—Chromium
February	6—Chromium
February	20—Acid zinc
March	6—Silver
March	20—Cyanide copper
April	3—Cyanide zinc
April	17—Cadmium
May	1—Brass
May	15—Brass
May	29—Gold

Mimeographed instructions will be furnished without extra charge. Frequent references will be made to the book "Principles of Electroplating and Electroforming", by W. Blum and G. B. Hogaboom, study of which will aid the members to more fully understand the lessons. The retail price is $4.50 but on orders of 5 or more copies, a discount of 20 per cent is granted, making the next price about $3.70 including postage.

DR. W. BLUM

NEWARK BRANCH

The regular meeting of the Newark Branch, A. E. S. was held on Friday Evening, December 4, 1936. The meeting was called to order at 8:45 p.m. with President Samuel Taylor, presiding. All officers were present with the exception of Samuel Glickenhaus, Trustee. The minutes of the previous meeting were read and approved.

An application for Nathan Sorenson was received and voted on to take the regular course.

The following members were reinstated: Daniel Davis, R. F. D. No. 9, Whippany, N. J.; Samuel Dlin, 486 Clinton Ave., Newark, N. J.; Fred Groh, 45 Peach Tree Rd., Maplewood, N. J.

Under the order of new business it was decided that Newark Branch should hold their Annual Educational Session and Banquet on or about the Saturday after Easter, the exact date to be given out later. Mr. Horace Smith was again appointed Chairman of that Committee.

Newark Branch will endeavor to get the 1939 Convention to Newark and the delegates to the New York Convention in 1937 will be instructed to use all their influence for that purpose. Mr. Horace Smith gave a very interesting talk on holding the 1939 Convention in Newark and stated that it should be, as Mr. George Hogaboom suggested in our previous meeting, "An International Convention". The Newark boys are quite enthused over this and they hope that all the other Branches are with them.

Our Librarian, Mr. Paul Oldam, spoke on "Gold Plating" and asked every member who had experience in gold plating to give him all the information they could so that Newark Branch could present an intelligent paper at the 1937 Convention. We had quite a few gold platers at this meeting and the subject caused quite a discussion.

The meeting adjourned at 11:15 p.m. There were 32 members present.

GEORGE WAGNER, *Sec'y*

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The regular meeting of the Newark Branch was held on Friday evening, Nov. 20th. The meeting was called to order at 8:30 with President Samuel Taylor presiding. The following officers were present: Samuel Taylor, President; John Kotches, Vice-President; George Wagner, Secretary; Nelson Sievering, Treasurer; Paul Oldam, Librarian; and William Hodecker, Trustee.

The minutes of the previous meeting were read and approved.

An application for Mr. Robert Raymond Sizelove was received and voted on to take the regular course.

Application for Mr. Wilbur G. Schmidt was reported on favorably and he was elected to Active Membership.

Application for Mr. Wm. F. Hodecker, Jr., was reported on favorably and he was elected to Active Membership.

Dr. Gustave Klinkenstein, one of our newly elected members, gave a very interesting talk, his subject being: "The Difference of Lacquering Various Metals". In his talk he explained how Lacquers have different properties adaptable to various metals. How some Lacquers must be resistant to soaps and greases and why all metals should have a Lacquer designed for their specific purposes. This talk caused quite a discussion. Mr. Horace Smith brought up the question: If a Lacquer which is used for silver, or designed for silver, would be just as good for brass and bronze, stating that he was using one Lacquer for all three metals with good results. Dr. Klinkenstein pointed out that if he had different Lacquers designed for each of these particular metals he would have still better results. He stated that some Lacquers would contract more than others and that Cotton Lacquers have very poor adhesion. He also stated that Lacquers take anywhere from two to twelve hours to dry. Dr. Klinkenstein was asked what caused "Blushing" on lacquered articles and he answered this by saying that "Blushing" was mostly caused by moisture in the air. Dr. Klinkenstein was given a rising vote of thanks by the 26 members present at the meeting.

Newark Branch was honored by a visit from our Executive Secretary, Mr. William J. R. Kennedy. He was called upon for some remarks and he gave us a little talk on the doings of the Supreme Society, the job of Executive Secretary and the coming Convention. He asked Newark Branch to present some paper at the coming Convention and it was decided that the subject for this paper would be "Gold Plating." Mr. Kennedy was so enthused over Dr. Klinkenstein's subject that he advised us to get some one who could take these talks down in shorthand, that they may be printed in the MONTHLY REVIEW for the benefit of all the branches.

GEORGE WAGNER, *Sec.*

GRAND RAPIDS BRANCH

SPECIAL NOTICE

Grand Rapids Branch will hold its meetings at the Y. M. C. A. till further notice.

The regular meeting of the Grand Rapids Branch, which was held Dec. 10 at 55 Mt. Vernon Ave., was called to order by President Morton.

The minutes of the previous meeting and several communications were read and approved.

It was purely a business meeting, the subject having many angles which were vital to the Branch and its members and the discussion required most of the evening.

We also discussed ways and means of making our meetings more interesting for its members.

Applications for active membership were made by Ferdinand Kucken, Peerless Novelty Co., and by Peter H. Vlug of C. L. Frost and Son, were voted upon favorably.

CHAS. S. WHALLEY, *Sec.-Treas.*

BINGHAMTON-ELMIRA BRANCH

The Binghamton-Elmira Branch of the A. E. S. held their monthly dinner meeting at the Y. M. C. A., Binghamton, October 5th. Dinner was served at 6:30 p.m. after which our President, Mr. Austin Fletcher, of Brewer Litchener Corp., read and explained in detail a paper which he had prepared on Cadmium Barrel Plating.

The main purpose of the paper is to aid the practical plater in arriving at a cost on his barrel plating. Although the figures were all given for cadmium other barrel plating can be figured the same way with a few changes.

Mr. Fletcher explained how to find the efficiency of the barrel, how to find the area of the work plated and how much metal is deposited per pound of work per hour. When a plater is working on one kind of work at a time it seems that the plan would be very satisfactory.

Our Vice-President, Mr. Merrett, of I. B. M. Corp., thought that in his own case where he plates many different kinds of work at one time, the plan would not work or be at all practical.

Everyone seemed to get a lot out of the paper and with the price of cadmium as it is, probably most companies are interested in whether they are depositing one or two pounds of metal.

LARRY MEYER, *Sec.*

LOS ANGELES BRANCH

Minutes of the Los Angeles Branch, American Electro-Platers' Society, regular monthly meeting held Wed., Nov. 11th, 1936, at the Rosslyn Hotel. President E. R. Williams presided. Ten members and two visitors were present.

Minutes and financial report of the previous meeting were read and accepted.

The secretary was instructed to work with Mr. Thornton to encourage the members who had dropped out in the past to become re-instated.

Mr. C. C. McLaren was elected as an active member.

Bills for per capita tax and postage were read and ordered paid.

Ray Bray, the librarian, found the following questions in the box:

Q. Should work be water rinsed between the silver strike and silver plating solution, or taken directly from the strike to the plating solution?

A. Direct from strike to plating solution.

Q. Give a formula for acid copper solution.

A. Copper sulphate 28 oz. Sulphuric acid 3 to 5 fluid ounces. Water one gallon. 7½ lbs. yellow dextrin to each hundred gallons solution makes the plate smoother. This solution should stand about 18 degrees Baumé.

Q. Give a formula for hard chrome solution and temperature at which it should be operated.

A. Chromic acid 1 lb. Anhydrous sodium sulphate 14 grams. Water one

gallon. One oz. boric acid crystals. Temperature 14° Fahrenheit. Current density 150 amps per sq. ft.

Q. What causes silver deposit to come out yellow?

A. May be caused by lack of cyanide, too much carbonate, or not enough metal.

EARL COFFIN, *Sec.-Treas.*

CLEVELAND BRANCH

Our regular meeting was postponed and instead we had our first supper and dance.

The party was well attended and there was a good time for everybody.

We had as an honored guest, Mr. George Hogaboom who stopped off on his way east.

Our next regular meeting will be January 9th, 1937.

W. E. O'BERG, *Sec.-Treas.*

ANDERSON BRANCH

Anderson Branch convened for a dinner meeting December 7th, at the Y. M. C. A. There were thirty-four members and guests present and after dinner President Minton expressed his appreciation for the fine turnout and welcomed the guests.

Librarian Bob Wagnew then introduced Mr. J. H. Hoefer, of the A. T. Wagner Co., of Detroit, makers of plating equipment and supplies. Mr. Hoefer spoke on the "Electro-Plating Circuit" and his talk was very interesting and well received. The subject dealt with rheostats and power losses, bus bar voltage drop, solution resistance, polarization, etc. Much discussion of considerable interest arose and after all questions were answered, the meeting was adjourned at 9 p.m.

LUCIEN R. HINSCH, *Sec'y*

CHICAGO BRANCH

The regular monthly meeting of Chicago Branch was held December 12, 1936, at the Atlantic Hotel.

President G. Jelinek presiding and all other officers present.

A letter from the New York convention committee regarding and requesting papers on practical plating experiences and problems, for the convention, read and placed on file.

An invitation from Detroit Branch to all members to attend their first dance, January 8, 1937, read and placed on file. Any Chicago Branch members who may be in Detroit on this date are urged to attend this social event.

Mr. H. A. Gilbertson reporting for the banquet committee stated that he expects the largest and best banquet ever held by Chicago Branch, January 16, 1937, in the Grand Ball Room of The Palmer House. Mr. O. E. Servis promises a very fine Educational Session in the afternoon.

The librarian found the following questions in the question box.

1. *A pipe ¼ inside diameter and one foot long with a wire anode is being plated inside, what restricts the amount of current, other than the solution strength of the cyanide copper solution?*

Ans. The small quantity of the solution in the pipe restricts the amount of the current that can be used.

2. *For chrome plating, would a cast lead antimony anode around a copper rod give better results than a bare lead anode? The copper rod running down the center of the anode the full length.*

Ans. There were several different opinions on this. One member stated that he was using this type of anode and it seemed to give better current distribution. Another member stated that if your lead anode was thick instead of thin that you would get just as good results without the

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danger of getting copper into your solution, should the chrome eat through the lead.

3. *What is a good brightener for cadmium solutions to plate cold rolled bright steel stampings?*

Ans. There are several good brighteners on the market. But it was also suggested that the following would give good results: Postum, Glue, Condensed Milk, and one member stated he was using sulphonated castor oil, about 1 pint of oil to 600 gal. of cad. solution.

4. *What is the maximum current density that can be used in a cleaner previous to chrome plating on nickel plated steel parts?*

Ans. It depends on the type of cleaner used and how good your nickel deposit is anchored.

J. W. HANLON, *Sec.*

DETROIT BRANCH

The regular meeting of the Detroit Branch, A. E. S., was held in the Hotel Statler on Friday evening, December 4th, with Mr. A. B. Wilson, President, presiding. There were 80 people present at this meeting, which very nearly makes a record for attendance at a regular meeting.

The minutes of the previous meeting were read and approved as read. A letter from Mr. Rolf of the New York Branch was read, and ordered placed on file. There were 4 new members elected.

There were 9 applications for membership read and referred to the Board of Managers for action. There were 9 suspensions on account of non-payment of dues.

Under the head of reports of committees: Mr. George L. Nankervis not being present, Mr. A. B. Wilson made the report that the new membership drive was progressing with good results.

Mr. A. B. Wilson also made the announcement of our first dance, which is to be held at Detroit Leland Hotel on Friday Evening, January 8th, and that there would be no regular business meeting on that evening. He also stressed the fact that we were not giving this event with the idea of making any money on it, and that $2.50 per ticket for a couple would no more than cover the expenses.

Mr. George Hogaboom, of the Hanson, Van Winkle, Munning Company, was then introduced as the speaker of the evening. It is needless to say that he was met with great applause, and

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George took it very graciously, and tried to come back, which he so graciously did. He had no paper, but gave an extemporaneous talk on plating in general, mentioning the new developments, and after this, of course, he got into the subject which had been advertised for the evening—namely, zinc plating. He had a number of slides which were thrown on a screen and gave descriptions of different deposits and actions with different temperatures and current densities, and he stressed a great deal on voltage. I could fill a page with the different things of interest in his talk, but George has covered practically all that he said in some of the papers that he has written and published. After his talk, there were questions asked and answered. Among those who asked questions were Mr. W. W. Phillips, of the Research Laboratory of the General Motors Corporation, and he gave some very interesting propositions, and George and he had quite a little time between themselves to the amusement and edification of us all. Then Mr. Gus Soderberg, of the Udylite Company, took exception to some of the things which George had brought out in his talk, but as usual, George was not floored at all, and in the discussion we all learned some things. Then Mr. Charles E. Eldridge, of the United Chromium Company, thought he had a chip on his shoulder that should be removed, and it was pretty hard to say who had the upper hand, but suffice it to say that altogether it was a very interesting and very educational, and anyone who could not have learned something from the talks must have been taking a nap. George was given a hearty vote of thanks and received much applause at the close of the discussion.

The question box was then taken up by acting librarian, Mr. B. F. Lewis, and there were some very interesting questions asked, and the answers given to them were also very edifying.

1. *What is the advantage of the Rochelle salt copper solution compared with the cyanide copper solution?*

Ans. The Rochelle salt permits the use of high temperature and low free cyanide, resulting in rapid deposit of fine grained metal without serious anode polarization or carbonate accumulations.

2. *What factors influence the throwing power in a sodium stannate tin solution?*

Ans. Most important is to keep the anode area relatively small so that oxygen evolved thereon will keep part of the tin ions oxidized without excessive use of hydrogen peroxide.

3. *How can it be proved that organic matter may be occluded in electroplating?*

Ans. In baths containing gulac, tests for cathode efficiency have shown more than 100% efficiency. This is indicative that occlusion takes place.

4. *Isn't purity of deposit more important than all other properties for resistance of deposit?*

Ans. For corrosion resistance, thickness is more important than purity. For tarnish resistance of the deposit itself, purity is important, as pure metals are usually less active chemically than impure metals.

5. *What is the composition of the Bethanizing solution (zinc plating)?*

Ans. Zinc metal 400 grams per liter. Sulphuric acid 250 grams per liter. Manganese salts as addition agents. Silver-lead insoluble anodes. Cooling coils for tem. control.

Mr. W. W. Phillips, Treasurer of the Research Committee, stated that they had about $2,000 in our treasury and that subscriptions and contributions were coming right along and that he saw no reason for any fear that we

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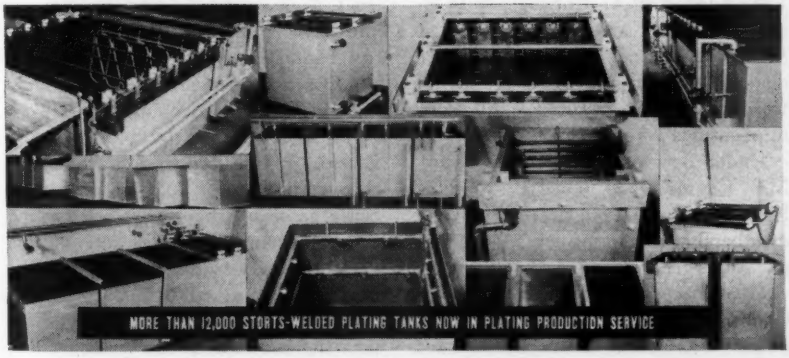

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would not come out all right financially during the year.

Mr. A. B. Wilson made the announcement that the Secretary would mail a letter to each member with tickets included for the dance, and that we expected all the members to take at least one ticket and sell as many more as they possibly can to their friends and the peddlers whom they come in contact with, and that everyone should be present at this dance, with their families and friends.

Meeting adjourned at 11 o'clock.

T. C. EICHSTAEDT, *Sec.-Treas.*

HARTFORD BRANCH

The Hartford Branch of the A. E. S. held its regular monthly meeting on Monday evening, Dec. 14, 1936, at the Elk's Club, Bristol, Conn.

The meeting was called to order at 8:15 with President Peterson in the chair. Minutes of the last meeting were read and accepted. All communications were read and placed on file.

Under new business one applicant, Mr. Raymond D. George, of East Hartford, Conn., was elected to active membership in the branch. Other applications received were as follows:

Mr. Clarence Tucker, Terryville, Conn., Active; Mr. Emil Goranson, Forestville, Conn., Active; Mr. Albert Maynard, New Britain, Conn., Active; Mr. N. E. Promisel, Meriden, Conn., Associate.

There being no speaker for the evening, time was spent in the discussion of various problems confronting the branch.

The meeting was adjourned at 11:00 p.m. V. E. GRANT, *Sec.*

WATERBURY BRANCH

An interesting meeting of Waterbury Branch, A. E. S., was held Friday evening, Dec. 11th, in Engineers' Hall. President Tennant Elwin presided. Communication relative to the supreme convention to be held in June 1937, was received from New York Branch. Wm. J. Gray reported on the progress of the Chemistry Class. George Musero also remarked on the subject giving an outline of the work that was planned. Also stated that the Lea Mfg. Co. had offered the use of its laboratory to the class, which was accepted and greatly appreciated.

Applications for membership were received from Joseph E. Thompson, Active, and Le Verne Verzin, Associate. Referred to the Board of Managers.

President Elwin introduced executive secretary Wm. J. R. Kennedy, who was paying the Branch an official visit. The secretary stated that during the past three months he had visited ten Branches. Conditions in most of the Branches seemed to be of a thriving nature. Remarked on the good work being accomplished by vice-president Patrick J. Sheehan and his membership committee. Told of the plans being made by the New York Branch for the coming convention, of the various papers to be presented by the Branches and asked "what was Waterbury Branch going to do?" Suggested that the outcome of the Question Box discussions along with all items of general interest to the plating fra-

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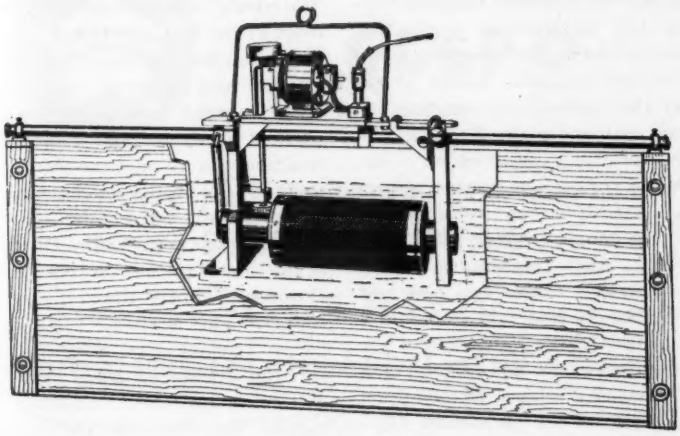

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ternity, be sent to the editor of the REVIEW for publication.

Touched on criticisms received concerning the methods of conducting business at the Branch meetings, and also the conventions. Called attention to the necessity of securing advertising matter for the REVIEW, the revising of the Constitution. Remarked on the lack of interest shown in the attendance at some of the Branch meetings. All in all, there was very much enthusiasm being shown in A. E. S. circles, and it seemed as if the Society had taken on a new lease of life. At the conclusion of the speaker's remarks a motion was passed that Waterbury Branch present a paper at the New York Convention, the title to be "Barrel Rolling of Metal Parts." It was announced that Mr. George Hogaboom would be the speaker at the January meeting.

W. F. GUILFOILE, *Sec.*

Here and There in Waterbury

Anyone spending a few minutes in Waterbury should visit the waiting room at the R. R. Station if they want to get an idea of the multitude of small articles manufactured in that city. Large wooden frames holding metal parts of all shapes and sizes from the common pin to chrome-plated bathroom fixtures are displayed prominently on the walls of the station.

It rained as never before all day, and at the time of the meeting it still rained. President Tennant Elwin invited us to supper. This is always a pleasure for us as Tennant was secretary of the Hartford Branch for many years, so we got well acquainted. Thanks for the supper, Mrs. Elwin, we had a most enjoyable time.

The meeting at Engineers' Hall was full of pep and enthusiasm. Bill Gray and George Muscio certainly seem to enjoy the chemical classes being held

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Waterbury Branch decided to present a paper at the New York Convention, on Ball Rolling. Waterbury does more ball rolling of small metal parts than any other city in the country. A paper on this subject should be well worth while. A committee was appointed consisting of Messers Ellsworth Candee, Bill Guilfoile, Bill Gray, and C. R. Prescott to secure the data. The paper will then be read by some foreman plater connected with the Branch.

Bill Guilfoile, the faithful secretary of Waterbury Branch, got warmed up during the discussions and told some of the experiences he had when he first attended the A. E. S. Conventions. Bill's reminiscences would make good reading if put in book form.

We would like to see Waterbury Branch grow so big that Engineers' Hall would be too small and cramped to hold them all.

We visited the Lea Manufacturing Co. on Saturday A. M., shook hands with Bob Leather, Earl Couch, Dick Crane, and George Muscio. We missed seeing Doc. Kellner.

It was a good meeting, well attended, and a nice spirit of optimism manifested regarding the future of the A. E. S.

Thanks Messrs. Elwin and Candee for the invitation.

NEW YORK BRANCH

The Branch held but one meeting during December, Friday, December 11th, being the date. Inasmuch as the second meeting would fall during the holidays it was decided not to hold it. This meeting was a joint business and educational session and was attended by thirty members.

After several Branch business matters were discussed and disposed of, the Educational session began with a talk on Bronze Plating by Mr. Henry Levine, vice-president of the Branch. A lively discussion followed and some of the members took issue with Mr. Levine on formulae and procedure. It was a very interesting topic for an hour.

The Branch has two scheduled meetings for January. On Friday, January 8th, the Branch will be favored by the presence of the executive secretary, Mr. W. J. R. Kennedy, who will address the Branch on that occasion. At the second meeting of January 22nd a representative of the General Electric Company will be there with a subject allied with the plating industry. The membership of the Branch anticipates much of interest at these two meetings and in particular will be glad to make the acquaintance of the new executive secretary of the A. E. S.

The meeting was adjourned at 11:15 P. M. F. J. MacStoker, *Sec.*

PROVIDENCE-ATTLEBORO BRANCH

The Branch held its regular meeting Friday, December 18, at No. 59 Chestnut St. This was the best meeting we have had for a long time.

There was a very interesting discussion on the "Different Phases of Deposits on Non-Metallics," carried on by Messrs Chase, Cahill, and Weisberg.

Also one on the analysis of solutions containing several alkalies—carried on by Messrs. Don Wood, Cahill and Weisberg.

At the next meeting, Mr. Wm. Cahill will speak on "Cleaners". The meeting will be at Narragansett Hotel, Room C, January 15, 1937, 8 p.m.

J. Andrews, *Sec.*

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Membership Report

To December 18, 1936

ELECTIONS

William F. Maher, 560 W. Third St., Fulton, N. Y.
Active, Binghamton-Elmira Branch

William E. Langenmayr, 515 S. Edward Ave. Syracuse, N. Y.
Binghamton-Elmira Branch

James J. Reagan, 213 Princeton St., E. Boston, Mass.
Associate, Boston Branch

Vincent Campisi, 87 Water St., Watertown, Mass.
Active, Boston, Branch

Ernest C. Andrews, 148 Wordsworth St., E. Boston, Mass.
Associate, Boston Branch

E. Jefferson Crum, The Bethlehem Steel Co., Wire Mill Bethanizer, Sparrows Point, Md.
Active, Baltimore-Washington Branch

Philip A. Patterson, 8900 Hubbell Ave., Detroit, Mich.
Associate, Detroit Branch

P. Allen Pinsoneault, c/o Oakite Prod. Inc., General Motors Bldg., Detroit, Mich. Associate, Detroit Branch

Robert B. Potter, 4268 Beuna Vista, Detroit, Mich.
Associate, Detroit Branch

Howard J. McAleer, 2431 Scotten Ave., Detroit, Mich.
Associate, Detroit Branch

Ferdinand Kucken, 907 Pennoyer Ave., Grand Haven, Mich.
Active, Grand Rapids Branch

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